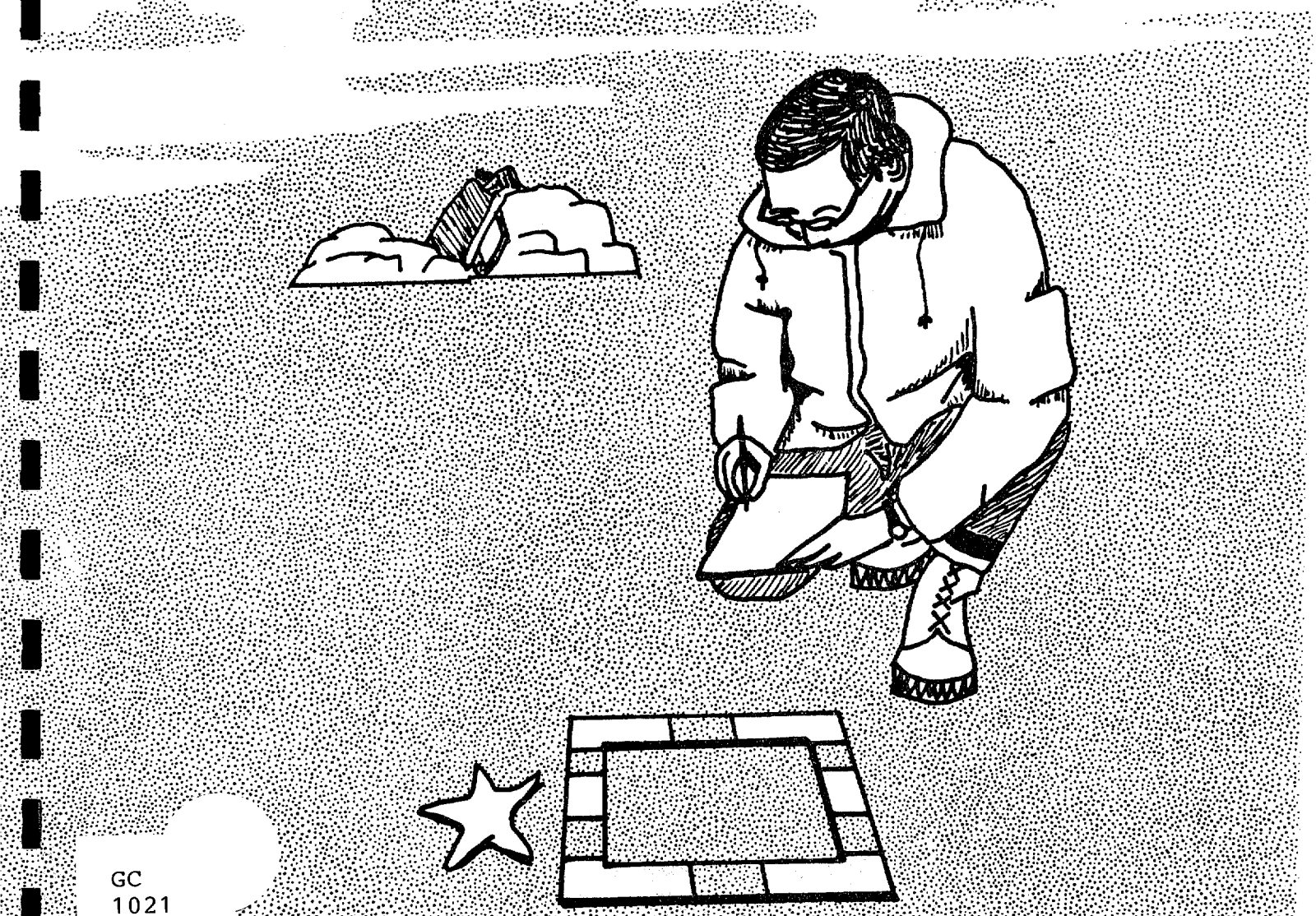
GUIDELINES:

MARINE RESOURCE DAMAGE ASSESSMENT PROGRAM



D.O.E. REPORT 80-15

State of Washington

Department of Ecology

December 1980

GUIDELINES: MARINE RESOURCE DAMAGE ASSESSMENT PROGRAM

Washington State's Marine Resource
Damage Assessment Contingency Plan

DOE Report 80-15

by

Harry B. Tracy
Kenneth Pierce

Office of Water Programs

State of Washington
Department of Ecology
Olympia, Washington

December 1980

Report Funded by
U.S. Office of Coastal Zone Management
Grant 04-8-MOI-349

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

TABLE OF CONTENTS - Continued

LIST OF FIGURES

FOREWORD

The need for an organized approach of government agencies, the academia, and the private sector to marine resource damage assessments in the marine and estuarine habitats of Washington State is widely recognized by the scientific community and state resource managers. Many of these people have been working toward this goal for some time.

Under Chapter 90.48 RCW, response to pollution-caused damages and assessment of those damages are Department of Ecology (DOE) responsibilities. The DOE accepts these responsibilities, but the DOE also recognizes the limitations of one agency when confronted with a large spill in the marine environment.

In an effort to provide a mechanism that will aid in coordinating the biological expertise of all state resource management agencies and the scientific community, the DOE in 1977 proposed the Marine Resource Damage Assessment (MRDA) program. MRDA was presented to representatives of the initial planning group of state resource management agencies (MRDA Planning Group) as a two-phase program: Phase I - Development; and Phase II - Implementation. At a meeting in December, 1977, the MRDA Planning Group representing the following agencies agreed to participate in MRDA Phase I, Phase II, or both Phase I and Phase II:

Department of Ecology
Department of Fisheries
Department of Game
Department of Natural Resources
Department of Emergency Services
Department of Social and Health Services
Parks and Recreation Commission

In 1978 a series of meetings was held between a nucleus of the MRDA Planning Group and experts in the various disciplines that are directly or indirectly affected during a pollution emergency. The fundamental

questions posed to the experts were: (a) In your area of expertise what losses do you feel that MRDA should assess for in the event of a serious pollution incident in the marine environment?; (b) What physical, biological, and economic resources in your area of expertise would be affected?; (c) Of the biological resources affected, which ones in your area of expertise should be ignored and not entered into the assessment because of time, personnel, financial, or other constraints? Individuals and agencies other than the participating state agencies contacted were:

Environmental Protection Agency (overall assessment)
U.S. Fish and Wildlife Service (birds)
National Marine Fisheries (NOAA) (fish)
Marine Mammal Laboratory (NOAA) (Marine mammals)
Dr. Terrence Wahl (consultant) (marine birds)
Dr. Steven Herman (Evergreen College) (marine birds)
Dr. David Mannuwal (University of Washington) (marine birds)
Dr. Herbert Webber (Western Washington University) (intertidal ecology)
Dr. Bruce Miller (University of Washington) (nearshore fish)
Dr. Kenneth Chew (University of Washington) (invertebrates)
Dr. Carl Nyblade (University of Washington) (invertebrate ecology)
Dr. June Siva (Atlantic Richfield) (industry)
Dr. Richard Vanderhorst (Battelle, N.W.) (fate and effects)
Dr. Andrew Driscoll (Oceanographic Institute of Washington) (marine biology)

In 1978 a grant application was submitted to Coastal Zone Management to fund the development of a marine resource damage assessment response plan. The information obtained from the meetings with the experts was used to demonstrate the MRDA concept.

The $78,000.00 grant was approved in 1979. In April 1979, one full-time employee was hired to serve as the MRDA project leader. The first draft of the MRDA Response Plan was completed and reviewed by the MRDA planning group in September of 1979. Since then, several drafts have been prepared and reviewed by a number of individuals.

At a suggestion of the MRDA Planning Group, four contracts were issued in May 1979. Dr. Bert Webber of Western Washington University and Drs. Bruce Miller and Ken Chew of the University of Washington were contracted to review and comment on the MRDA plan. Dr. Terry Wahl was contracted to develop procedures for assessing damages to aquatic waterfowl and provide baseline data for the damage assessment to these birds. These contracts were fulfilled in August and September of 1980. The recommendations, comments, and data have been reviewed and where appropriate, incorporated into the MRDA Plan.

The drafters and the DOE administrators feel that the MRDA program Phase I has been tremendously successful. This judgment was based on the dedication and interest of the many people who have contributed their time and effort into the development of this needed program. They also feel that implementation will be equally successful if this same spirit persists.

ACKNOWLEDGMENTS

We wish to thank the members of the MRDA Planning Group and the federal agency advisors who contributed their time and ideas to the development of the MRDA program. We also wish to thank the fish and wildlife experts who provided technical information and the numerous individuals who reviewed and commented on the draft manuscripts. Special thanks go to Rick Cardwell (WDF), Dave Jamison (DNR), Fred Gardner (DOE), John Sainsbury (EPA), and Bob Clark (NMFS, NOAA) for their dedication to the MRDA program and to Carol Perez for her patience in typing this document.

The Marine Resource Damage Assessment Program was developed under Grant Number 04-8-MOI-349 from the Office of Coastal Zone Management.

HARRY B. TRACY
KENNETH PIERCE
Department of Ecology

EXECUTIVE SUMMARY

GUIDELINES: MARINE RESOURCE DAMAGE ASSESSMENT PROGRAM

INTRODUCTION

Under Chapter 90.48.142, Revised Code of Washington, the Washington State Department of Ecology (DOE) is charged with the responsiblity for investigating environmental damages resulting from unlawful discharges into state waters of any organic or inorganic material which is detrimental to water quality or harms or kills the associated biota, assessing the extent of those damages, and initiating recovery of monetary damages through the State Attorney General. The DOE freshwater resource damage assessment program has been in effect since 1967. The guidelines for this program are adaptable for use in assessing minor incidents in fresh and marine waters. However, neither DOE nor any other single state agency has the expertise and personnel to assess environmental damages resulting from a major pollution incident in Puget Sound or the coastal areas of Washington State. What is needed in such an event is a resource damage assessment task force composed of experts from each of the resource management agencies. The Marine Resource Damage Assessment (MRDA) Program fills this need. Participating agencies are the Departments of Ecology, Fisheries, Game, Natural Resources, Emergency Services, Social and Health Services, and the Parks and Recreation Commission. Advisory personnel from the federal response agencies also are active in the MRDA group. MRDA was developed under Grant Number 04-8-MOI-349 through the Office of Coastal Zone Management.

MRDA GUIDELINES ORGANIZATION

Section ONE of the MRDA Guidelines contains the introduction which includes background information, authority, and purpose. Section TWO

describes the jurisdiction and responsibilities of the participating state and federal agencies. Section THREE describes the response plans of various state and federal agencies and explains how these plans interact with the MRDA response. Sections FOUR and FIVE describe the administration, alert, and activation of MRDA and Section SIX describes the MRDA response. Section SEVEN outlines the logistics and commitments of the participating state and federal agencies. Sections EIGHT and NINE discuss the scope of the damage assessment and the violator's liabilities, respectively. Section TEN explains the documentation of damages and Section ELEVEN outlines the formats for reports.

The Appendices supply technical and supportive information. Appendices VIII, IX and X provide detailed methodologies for field and lab sampling and analysis.

The MRDA plan has been prepared in a loose-leaf format. Each section and each appendix is tabbed. Periodic updatings will be made by DOE.

Goals and Objectives

The objectives of MRDA are to develop a state resource damage assessment program that organizes experts from the resource management agencies into a damage assessment task force. The task force will have the capability to respond to significant incidents, compile the data, and prepare a resource damage assessment that will be supported by local, state, and federal government agencies and the scientific community. The MRDA objectives also are to develop and publish a detailed response plan that describes the administrative and technical activities of the MRDA response. In addition the MRDA program will:

- Coordinate the state's damage assessment response with the national pollution response effort through state membership on the federal Regional Response Teams.

- Advise the On-Scene Coordinator (OSC) and RRT on methods and priorities for natural resources protection.

- Ensure maximum recovery of monetary damage assessments from the violator(s) in each significant incident.

MECHANICS

Alert procedures for the MRDA program are integrated with the pollution reporting system of the state and federal agencies in Washington State. MRDA is alerted whenever the DOE Spill Response Center is activated. Response occurs whenever significant resource damages are reported by the DOE regional staff or one of the cooperating response agencies.

MRDA is directed through two committees; an Administrative Committee (AdCom), and a Technical Committee (TeCom). MRDA is activated when the Director of the DOE Spill Response Center activates AdCom and TeCom.

AdCom will function as the manager/administrator of the MRDA damage assessment response. AdCom is the problem-solving unit for the overall response. Members of this committee work with the Governor's Office and the administrators of the state and federal agencies to keep the program mooving. They seek funding, personnel, and equipment whenever it is needed. They also tend to logistics problems. If some aspect of the assessment is faltering because of personnel or funding constraints, AdCom will make the decision to take corrective action or drop that portion of the project.

TeCom functions as the manager of the technical aspects of the MRDA damage assessment. TeCom will act as the information gathering and dispensing medium for all participants of the damage assessment task force. Information on location and extent of damages will originate with the On-Scene Coordinator's field forces. It will be passed to TeCom through the DOE representative to the OSC's team. TeCom will forward the information through the state agency coordinators to the field teams. TeCom also will collate field data, coordinate with federal damage assessment participants, and maintain a chronological log. The AdCom/TeCom subcommittees will prepare the MRDA environmental damage assessment.

Whenever MRDA is activated, AdCom and TeCom meet and set up communications. The flow of resource damage information is from the field to the TeCom through the DOE representatives on the Region X Regional Response Team and the Federal On-Scene Coordinator's team. TeCom members notify their respective agency coordinators of the resources they manage. Resource damage assessment information is returned to TeCom from the agency field teams by the agency coordinators. The outcome is one damage assessment supported by all participating agencies.

Scope of Monetary Resource Damage

The monetary resource damage assessment will include damages or losses to the physical, biological, and economic resources of the State of Washington. These losses or damages will be presented in terms of the dollar value of the resource damaged.

Physical - Physical parameters include man-made structures such as boat launches, navigational buoys, public beach facilities, equipment, and natural formations of recreational or commercial value such as reefs, exposed rocks, and beaches.

Biological - While a violator is liable for the loss of all plant and animal organisms, budgetary and personnel constraints of the state resource management agencies limit the scope of the assessment to those organisms having a direct or indirect established monetary value. Organisms for which monetary values cannot be established will be included as other affected biomass. If unanticipated funds become available, a long-term study of greater scope may be implemented.

Economic - The violator is liable for the cost of restocking the body of water, replenishing the affected resources, and restoring the body of water to its pre-injury state. The economic parameters include the loss in revenue to public agencies from state facilities such as parks, shorelands, beaches, and waters, providing such losses can be related to the pollution incident. Losses in tax revenues, licenses, and fees also may be included.

1.0 - INTRODUCTION

The marine and estuarine waters of Washington State play a major role in the transport of petroleum and other toxic substance cargoes along the west coast of the United States. Although a major pollution incident has never occurred in these waters, several significant spills causing environmental damage have occurred and minor non-significant spills are common. The potential for major incidents exists and will increase if Washington becomes a major shipping terminal for crude oil and other petroleum products.

Should a major discharge of oil or other toxic substance occur in Washington waters or adjacent Canadian waters, lands and aquatic resources under state and federal government jurisdiction as well as privately owned and Canadian properties and interests may be damaged. Efficient assessment of any environmental damages requires a fast, accurate, and coordinated response by various state and federal agencies. Inadequate data collection or disagreements in the interpretation of data resulting from the lack of communication and cooperation between investigating groups may invite court rulings detrimental to the public's interests. The results of damage assessments for such major spills as the Argo Merchant (1976) and the IXTOC I well blowout (1979) has emphasized the need for coordination between responding agencies.

Response procedures to illegal discharge of oil and other hazardous materials in U.S./Washington State waters are outlined in federal and state contingency plans. Under these plans, the Environmental Protection Agency is designated the lead agency for coordinating the environmental damage assessment at the federal level while Washington State assumes a lead role in environmental protection and resource damage assessment at local and state levels.

The Washington State Marine Resource Damage Assessment (MRDA) Program provides the organizational framework for integrating the resource damage assessment response of state agencies and the mechanism for

coordinating the state's response with the national environmental damage assessment response effort. Publication of the MRDA guidelines completes the developmental phase (Phase I) of the program. Phase II will include training of personnel and implementation of the program.

1.1.0 - Background

The Washington State Department of Ecology (DOE) is charged with the responsiblity of determining pollution-caused damages to the waters of the state and for recovering monetary damages from the discharger in an action brought by the Attorney General on behalf of the people of the State of Washington (RCW 90.48.142). Since it is impractical for one state agency to assess damages resulting from a major pollution incident, DOE staff sought the assistance of other state conservation and resource management agencies to devise an integrated state response program which could be coordinated with the federal response. These agencies agreed to participate in the development or implementation of the MRDA Program. Their representatives formed the MRDA Planning Group:

Ken Pierce, Project Leader	Dept. of Ecology
Harry Tracy	Dept. of Ecology
Fred Gardner	Dept. of Ecology
Rick Cardwell	Dept. of Fisheries
James Hall	Dept. of Emergency Services
David Heiser	Parks & Recreation Commission
Lora Leschner	Dept. of Game
Max Hayes	Dept. of Social & Health Services
David Jamison	Dept. of Natural Resources

Federal Advisors

John Sainsbury	Environmental Protection Agency
Howard Harris	National Oceanic & Atmospheric Admin.
Robert Clark	National Marine Fisheries Svc., NOAA
Robert Everitt	National Marine Fisheries Svc., NOAA
Randall Smith	U.S. Fish & Wildlife Service

The MRDA Planning Group was the backbone of the developmental phase. All aspects of program development and planning were reviewed by this group prior to publication of the guidelines.

1.2.0 - Objectives

1. To Develop and publish a Marine Resource Damage Assessment Response Plan (Phase I). The plan will address damage assessment incidents in marine waters but may be employed in fresh, marine, or estuarine waters.

2. To Develop an interagency strike force to be deployed whenever the Marine Resource Damage Assessment Response Plan is implemented (Phase II). This response group will include, in addition to state personnel, members of the federal response agencies and members of the scientific community. Interagency coordination with the federal spill response activity will be accomplished through the state's participation on the federal Regional Response Team and the On-Scene Coordinator's team as defined in the *Oil and Hazardous Substance Pollution Contingency Plan for Standard Federal Region 10*.

1.3.0 - Scope

The MRDA Plan provides guidelines for a coordinated environmental damage assessment response of state and federal agencies and the scientific community to significant pollution incidents that occur in Washington State marine and estuarine waters. The initial damage assessment activities of the state agencies will be conducted to address state law and dwell on those biological, physical, and economic parameters for which a direct or indirect dollar value can be established. Damage assessment activities of federal agencies, coordinated through MRDA, will be directed at organisms

and ecological factors without establishable dollar values. However, some federal entities may provide support to the state's damage assessment activities.

The MRDA damage assessment response effort, augmented by the data collected by the federal agencies, will culminate in a single, comprehensive resource damage assessment supported by the state and federal agencies and the scientific community. Data from the MRDA resource damage assessment will be used to generate a monetary damage assessment to be submitted to the State Attorney General for the recovery of monetary damages. The monetary damage assessment will fulfill the damage assessment responsibilities of the Director of the DOE and the federal On-Scene Coordinator. A long-term environmental damage assessment may be conducted pending availability of funds.

1.4.0 - Concept

The plan assumes that in the event of a major pollution incident, state and federal resource management agencies will conduct an impact assessment on the resources they manage. The plan does not impose additional responsibilities upon the participating agencies or entities; however, it does encourage a coordinated response whenever a major pollution incident occurs. The MRDA plan provides guidelines for standardizing damage assessment methods and sampling techniques. It also provides a vehicle for gathering and dispensing information needed to coordinate the assessment activities of state and federal agencies and response groups. The outcome will be an assessment of resource damages produced and supported by the involved agencies and entities. Data for the MRDA monetary resource damage assessment will be obtained through the MRDA response effort. Data gathered during any long-term environmental damage assessment may be processed through the MRDA system.

1.5.0 - Authority

The MRDA Program was developed to fulfill the requirements of:

1. Chapter 90.48.142 of the Revised Code of Washington; and

2. National and Federal Region X Inland and Coastal Contingency Plans for Spills of Oil and Hazardous Substances.

1.6.0 - Purpose

1.6.1 Provide a marine resource damage assessment capability for Washington State.

1.6.2 Integrate the damage assessment response of the state resource management agencies responding to significant pollution incidents in marine and estuarine habitats of Washington State.

1.6.3 Coordinate the state's damage assessment response with the national spill response effort through state membership on the federal Regional Response Team (RRT) and various federal response teams (Appendix III).

1.6.4 Recruit local scientists to assist in the development and to participate in the implementation of the MRDA program.

1.6.5 Produce a single comprehensive environmental damage assessment for each significant pollution incident, supported by local, state, and federal agencies and members of the scientific community.

1.6.6 Ensure maximum recovery of monetary damage assessments from the violator(s) in each significant incident based on information contained in the MRDA resource damage assessment.

1.7.0 - Abbreviations

1.7.1 State Agencies

DES	Washington State Department of Emergency Services
DNR	Washington State Department of Natural Resources
DOE	Washington State Department of Ecology
DSHS	Washington State Department of Social and Health Services, Health Services Division
P&RC	Washington State Parks and Recreation Commission
WDF	Washington State Department of Fisheries
WDG	Washington State Department of Game

1.7.2 Federal Agencies

EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
NOAA	National Oceanic and Atmospheric Administration
U.S.	United States
USCG	U.S. Coast Guard

1.7.3 Action Phase Abbreviations, State and Federal

DOE OSC	DOE On-Scene Coordinator

DOE SRC	DOE Spill Response Center
MRDA	Marine Resource Damage Assessment Program (Washington State)
TeCom	MRDA Technical Committee
AdCom	MRDA Administrative Committee
OSC (Federal)	On-Scene Coordinator (Captain of the Port [USCG] or predesignated EPA official)
FWPCA	Federal Water Pollution Control Act (Clean Water Act) Section 311, Public Law 95-217
RRT	Regional Response Team for Federal Region X
SST	National Scientific Support Team
SSC	Scientific Support Coordinator (EPA/NOAA)
NRC	National Response Center
NRT	National Response Team

1.8.0 - Definitions

For purpose of this report, the following definitions apply:

1.8.1 Monetary Resource Damage Assessment

For purposes of this plan, a monetary resource damage assessment is a documentation of biological, physical, and economic damages incurred by the marine resources of Washington State as a result of a pollution incident and presented in terms of U.S. dollars. The resource damage assessment is designed to fulfill the requirements of RCW 90.48.142 and applies to those resources that have an establishable monetary value.

1.8.2 Environmental Damage Assessment

For purposes of this plan, environmental damage assessment is a long-term, comprehensive investigation designed to study the acute and chronic effects of a pollutant on the organisms of the marine environment and their recovery.

1.8.3 Baseline Studies

Sampling programs (historical or on-going) which establish a statistical data base for the spacial and temporal variability of organisms or other environmental factors at specific or regional sampling areas.

1.8.4 Response

Any activity under this plan or other state/federal oil and hazardous material spills contingency plans.

1.8.5 Oil and Hazardous Material

Oil - Any petroleum or petroleum derivative.

Hazardous Material - Any substances listed as hazardous materials in P.L. 95-217, and any materials that may be added to the list.

1.8.6 Environment

The conditions, circumstances, and influences surrounding and affecting the development of an organism or group of organisms.

1.8.7 Marine Environment (Washington State)

Puget Sound and adjacent waters, Strait of Juan de Fuca and adjacent U.S. waters, and Washington's outer coastal waters within the state's three-mile offshore jurisdiction.

1.8.8 Estuarine Environment

Brackish water areas at river mouths.

1.8.9 Pollution Incident

Any incident, voluntary or accidental, which results in the illegal discharge of oil or other hazardous material into marine or estuarine waters of the State of Washington.

2.0 - PARTICIPATING AGENCIES

The DOE has specific legislative responsibilities for determining the environmental impact of spilled oil and other hazardous materials under RCW 90.48.142. The Federal Water Pollution Control Act (Clean Water Act) (P.L. 95-217, Section 311(a)) requires the administrator of the Act (the Environmental Protection Agency) to determine the environmental impact of spilled oil or other hazardous materials. Other state and federal agencies have specified responsibilities to protect resources under their jurisdiction or response duties mandated by federal law as outlined in the Federal Region X Contingency Plan.

2.1.0 - State Agencies

2.1.1 - Department of Ecology (DOE)

Under Chapter 90.48 RCW, the DOE is the state agency charged with the responsibility for water pollution emergencies within the State of Washington. The DOE functions on the regional concept with headquarters in Olympia and regional offices in Redmond, Spokane, Union Gap, and Tumwater.

The DOE has four statutory responsibilities with respect to oil and other hazardous material spills: (1) to respond to each reported incident in an effort to identify the source, cause, and the responsible party; (2) to ensure that cleanup action is initiated and adequate; (3) to initiate enforcement action as necessary; and (4) to assess environmental damages. This plan addresses the last obligation; the first three are covered under the state's *Contingency Plan for Spills of Oil and Hazardous Substances*. Under the Federal Region X Contingency Plan, DOE serves as the state's lead agency for natural resources protection. All DOE response activities are coordinated through the DOE Spill Response Center.

2.1.2 - Department of Fisheries (WDF)

WDF has jursidiction over food fish, shellfish, hatcheries and associated structures and facilities, some beach access properties, and assorted equipment which may be affected by large spills of oil or other hazardous materials.

2.1.3 - Department of Game (WDG)

WDG has jurisdiction over all wildlife, game fish, and non-game fish. Of special concern in event of an oil or hazardous substance spill are water birds, marine mammals, aquatic furbearers, anadromous game fish, wildlife habitat areas, hatcheries, launching ramps and related facilities, and assorted equipment.

2.1.4 - Parks and Recreation Commission (P&RC)

P&RC has jurisdiction over several underwater parks, shoreside parks, beach properties, tie-up buoys, launching ramps and related recreational facilities and assorted equipment which may be damaged by large spills of oil or other hazardous materials.

2.1.5 - Department of Natural Resources (DNR)

DNR has jurisdiction over several artificial reefs, beaches and tidelands, beds of U.S. waters, and assorted equipment which may be affected by large spills of oil or other hazardous materials.

2.1.6 - Department of Emergency Services (DES)

DES's functions within MRDA are in the area of human services; i.e., interaction with local governments and state agencies such as the State Patrol and the Governor's Office, public notification and updating of the status of the pollution incident, and other emergency services which support activation and operational activities of MRDA.

2.1.7 - Department of Social and Health Services, Health Services Division (DSHS)

DSHS has jurisdiction over beach closures for human health and safety, utilization of contaminated food organisms, and general health-related matters for the safety of the public.

2.2.0 - Federal Agencies

Participation of federal agencies in oil and hazardous substance pollution incidents is defined in the National Contingency Plan and the Federal Region X Contingency Plan, both of which outline response procedures for spill containment, cleanup, disposal, and enforcement.

In Washington State, federal agencies operate under a functional group concept as outlined in the Federal Region X Contingency Plan. Individual groups undertake specific spill response tasks. The resource damage assessment task is the responsibility of the Scientific Damage Assessment Group of which the EPA is the coordinator. DOE is a member of this group in behalf of the State of Washington (Section 3.0). Other involved federal agencies and their spill response activities follow:

2.2.1 - Department of Transportation (DOT)

a. U.S. Coast Guard (USCG)

The USCG has basic investigative and enforcement responsiblities for unlawful discharge on all U.S. navigable waters.

The USCG has primary responsibility for policing spills of oil and hazardous substances that occur on coastal waters and the Columbia River below Bonneville Dam. USCG representatives investigate circumstances surrounding each incident and direct spill containment, resource protection measures, cleanup procedures, and disposition of contaminated materials. The USCG also administers the Federal Revolving Fund. Although not a member of the damage assessment group, the USCG serves as the federal On-Scene Coordinator (OSC) for containment and cleanup of oil and hazardous substance spills in marine and estuarine waters. They also provide logistical support to agencies involved directly in the environmental damage assessment.

2.2.2 - Environmental Protection Agency (EPA)

The EPA has primary responsibility for policing spills of oil and hazardous substances that occur on inland U.S. waters of Washington State as defined in the National Contingency Plan and Federal Region X Contingency Plan. For Washington waters, EPA Region X has delegated predesignated On-Scene Coordinator (OSC) responsibility to DOE. EPA Region X retains the responsibility for coordinating federal damage assessment efforts and ensuring the completion of a comprehensive environmental damage assessment report. In marine waters, EPA serves as coordinator of the federal damage assessment functional group as outlined in the Federal Region X Contingency Plan.

2.2.3 - Department of the Interior (DOI)

a. U.S. Fish and Wildlife Service (USFWS)

USFWS is the lead agency for the protection and assessment of damages to fish and wildlife populations endangered or affected during an oil or hazardous substance pollution incident in Washington's waters. USFWS operates under the authority of the Endangered Species Act, the Migratory Bird Treaty Act, the Marine Mammal Protection Act, and the Anadromus Fish Act. USFWS's responsibilities as DOI lead agency are outlined in the Federal Region X Contingency Plan and National Contingency Plan.

b. Other DOI Agencies

U.S. Geological Survey, Bureau of Land Management, National Park Service, Heritage Conservation and Recreation Service, and Bureau of Mines, as outlined in the Federal Region X Contingency Plan, will provide support to USFWS during a damage assessment. These agencies may participate actively in the damage assessment if resources under their jurisdiction are affected.

2.2.4 - Department of Commerce (DOC)

a. National Oceanic and Atmospheric Administration (NOAA)

The DOC through NOAA shall provide scientific expertise on living marine resources for which it is responsible, including endangered species and marine mammals. In addition, NOAA will coordinate scientific support in coastal areas; provide current and predicted meteorological, hydrologic, ice conditions and oceanographic conditions for the high seas, coastal, and inland waters;

provide charts and tide/current information for coastal and territorial waters; assist EPA in damage assessment in coastal regions and on the high seas. This information and service will be available to the State of Washington through the NOAA RRT member, the federal On-scene Coordinator, or the federal Scientific Support Coordinator (SSC).

2.2.5 - Other Federal Agencies

As outlined in the Federal Region X Contingency Plan, all other agencies, upon request of the EPA either directly or through the federal OSC, may provide assistance within their operating limitations.

3.0 - INTERAGENCY DAMAGE ASSESSMENT COORDINATION

Section 311 of the Clean Water Act requires the federal OSC to assess damages resulting from spills of oil and hazardous substances on U.S. waters. RCW 90.48.142 charges the Director of the Department of Ecology with the responsiblity for assessing pollution-caused damages resulting from unlawful discharges into state waters. Since both state and federal agencies are legally responsible for resource damage assessments, close coordination between state and federal agencies in planning for and implementing resource damage assessment response activities is of utmost importance.

The DOE has been closely coordinating with the EPA and the USCG through spill response activities since 1970. The DOE is an active member of the Federal Region X Regional Response Team and the federal OSC's team. These channels have provided an excellent line of communication between the state and federal agencies regarding spill response.

Although spill response and damage assessment response are closely associated within the total response effort, the objectives of the two phases differ radically. Spill response is aimed at removal, disposal, and enforcement; whereas damage assessment activities are aimed at evaluating the damages done to the physical, biological, and economic resources of the affected area. Yet the administrators of the response activities have a responsiblity toward both aspects of the overall response effort. Since the channels for communications and coordination in spill response are well established through state and federal spills contingency plans, these channels also will be employed for coordinating resource damage assessment activities.

This section summarizes the various contingency plans and damage assessment responsibilities of the participants and describes the coordination of the MRDA damage assessment activities.

3.1.0 - Oil and Hazardous Substances Spill Contingency Plans

Federal pollution response contingency plans written under the authority of the Clean Water Act outline the responsibilities of federal agencies during the illegal discharge of oil or hazardous substances in U.S. waters.

Washington State's oil and hazardous substance spill response contingency plan, written under the authority of Chapter 90.48 RCW, outlines the response procedures of state agencies (DOE, lead agency) during an illegal pollution incident involving state waters.

3.1.1 - Department of Ecology's (DOE) *Contingency Plan for Spills of Oil and Hazardous Substances*

The DOE's Contingency Plan provides guidelines for a coordinated response of federal, state, and local government agencies and the private sector to spills of oil and other hazardous substances that affect the "waters of the state" as defined in Chapter 90.48 RCW. It is designed to protect the public health and the environment during spill emergencies.

The DOE's Contingency Plan describes the activation and operational procedures of the DOE response during spill emergencies. The Plan activates the DOE Spill Response Center and identifies the DOE Spill Coordinator, the DOE On-Scene Coordinator (DOE OSC), their duties and responsibilities. It also establishes procedures for spill reporting, identification of the discharger, disposal of wastes collected during cleanup, personnel training, international cooperation, other administrative activities, and the activation of a damage assessment. The DOE Plan is written to provide communications channels between state and federal response groups and to coordinate the state response with the federal response effort.

3.1.2 - *National Oil and Hazardous Substances Pollution Contingency Plan*

The primary purpose of the National Contingency Plan is to establish federal policy with regard to spill response activities in U.S. waters and to provide guidelines for preparation of the federal regional spill response plans. The national plan was developed in compliance with P.L. 95-217, section 311(c)(2). The Plan applies to all participating federal agencies and is in effect for U.S. waters and adjoining shorelines, the contiguous zone, and the high seas beyond the contiguous zone in connection with activities under the Outer Continental Shelf Lands Act or the Deep Water Port Act, or waters which may affect natural resources belonging to, appertaining to, or under exclusive management authority of the U.S.

The National Contingency Plan addresses the responsibilities of federal agencies during a pollution incident in U.S. waters, establishes the National Response Team (NRT) and outlines its duties, establishes the National Response Center (NRC), defines the duties of the Federal On-Scene Coordinator (OSC), authorizes the establishment of and defines the duties of the Regional Response Teams (RRT), establishes special pollution control forces, and outlines the mechanisms for coordinating the response of state and local governments, private industry, academic groups, and the federal agencies. The Plan addresses discharge prevention, containment, removal, cleanup and disposal, environmental damage assessment, vessel removal or destruction, use of dispersants and other chemical control agents, and mitigation of costs.

3.1.3 - *Oil and Hazardous Substance Pollution Contingency Plan for Standard Federal Region X*

The Federal Region X Contingency Plan applies to Standard Federal Region X which includes Washington, Oregon, Idaho, and Alaska.

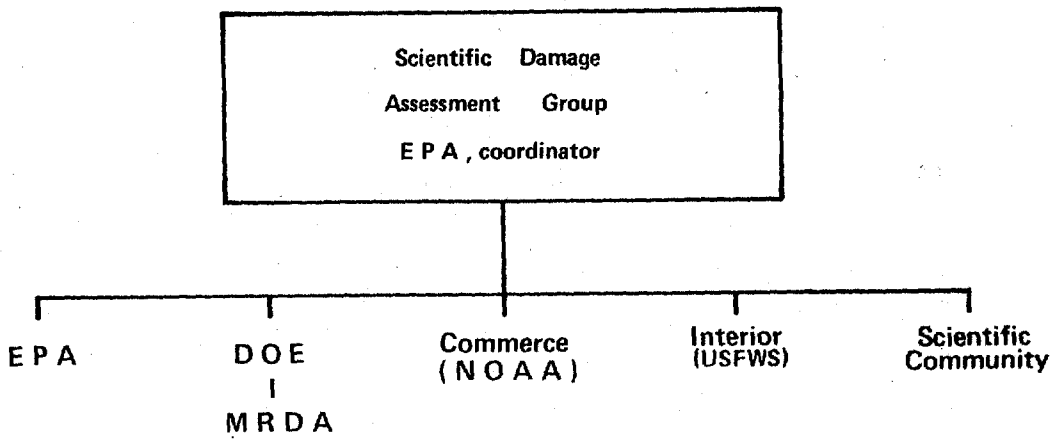
The Federal Region X Contingency Plan is effective for all waters of the U.S. within Standard Federal Region X, adjoining shorelines, the contiguous zone, and the high seas where a threat exists to U.S. waters, shoreline, or bottom. It places responsibility for containment, disposal, removal, enforcement, and related activities on the predesignated on-scene coordinator.

The Federal Region X Contingency Plan establishes federal and state agency membership to the Regional Response Team (RRT) and defines the duties of the participating agencies. It also establishes the RRT activation and response procedures and establishes the Regional Response Center. The RRT is the coordinating vehicle to combat significant spills within Standard Federal Region X.

Participating agencies on the RRT are arranged in functional groups with each functional group assigned specific duties. For example, the USCG is the functional group leader for spill cleanup and disposal with the state and EPA assisting; NOAA has spill trajectories and weather predictions; the state has resource protection with EPA assisting; and EPA has resource damage assessments with the state, the U.S. Fish and Wildlife Services, and NOAA assisting. Each agency may be a member of more than one functional group.

As outlined in the Federal Region X Contingency Plan, the federal spill response is implemented through the functional group concept. Whenever the Regional Response Team is activated, the On-Scene Coordinator consults a functional group leader for the status of that phase of the overall response. EPA serves as team leader of the resource damage assessment functional group. Membership in the resource damage assessment functional group consists of the Environmental Protection Agency (lead agency), National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Services, State Department of Ecology, and recruited members of the academic community. The representative for the State Department of Ecology also represents MRDA (Figure 1).

FIGURE 1. Membership in the Federal Scientific Damage Assessment Group.



During RRT activation, members of the resource damage assessment functional group will undertake specific tasks of the damage assessment based on agency jurisdiction and expertise. In addition, each participant will support, within operational limitations, the other participants. Pollution damage information will flow from the spill scene to the MRDA participants through State Department of Ecology representatives on the resource damage assessment functional group. Damage assessment data will flow from the MRDA teams to the On-Scene Coordinator through the State Department of Ecology representative on the damage assessment functional group. Data from all state and federal agencies will be included in the environmental damage assessment.

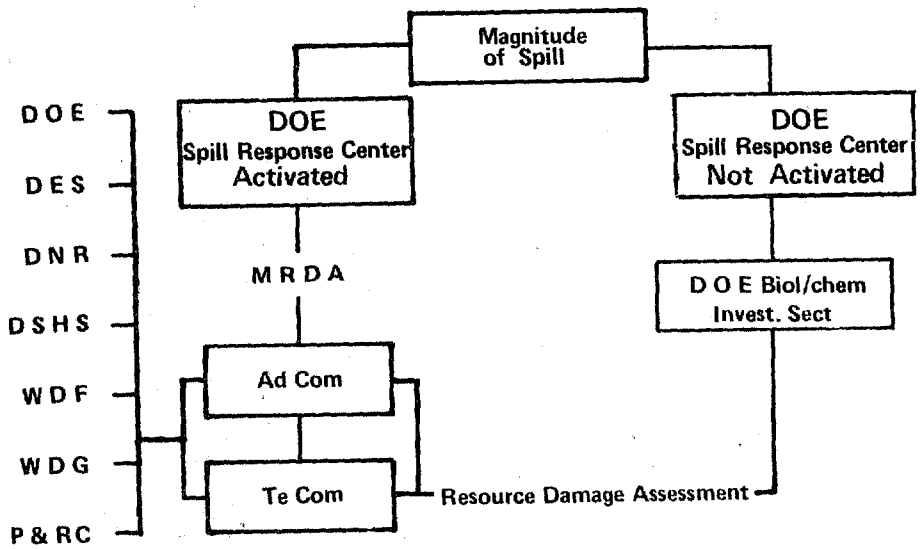
3.2.0 - State Agency Resource Damage Assessment Coordination

The Department of Ecology is the state agency responsible for maintaining the quality of Washington's waters. The DOE is under

legislative mandate to enforce the State Water Pollution Control Act which includes the Liability for Damages Statute, RCW 90.48.142.

State resource and conservation agencies have management and protection responsibilities for the environmental resources of the state. These agencies will respond whenever damages are inflicted upon the state resources that they manage. Damages from localized spills of minor impact will be assessed by the DOE staff with the assistance of the resource management agency. When MRDA is activated during widespread spills of significant impact, these agencies may be requested to field damage assessment teams and equipment on a continuing basis as described in this MRDA Response Plan (Figure 2).

FIGURE 2. M R D A Coordination of State Agencies

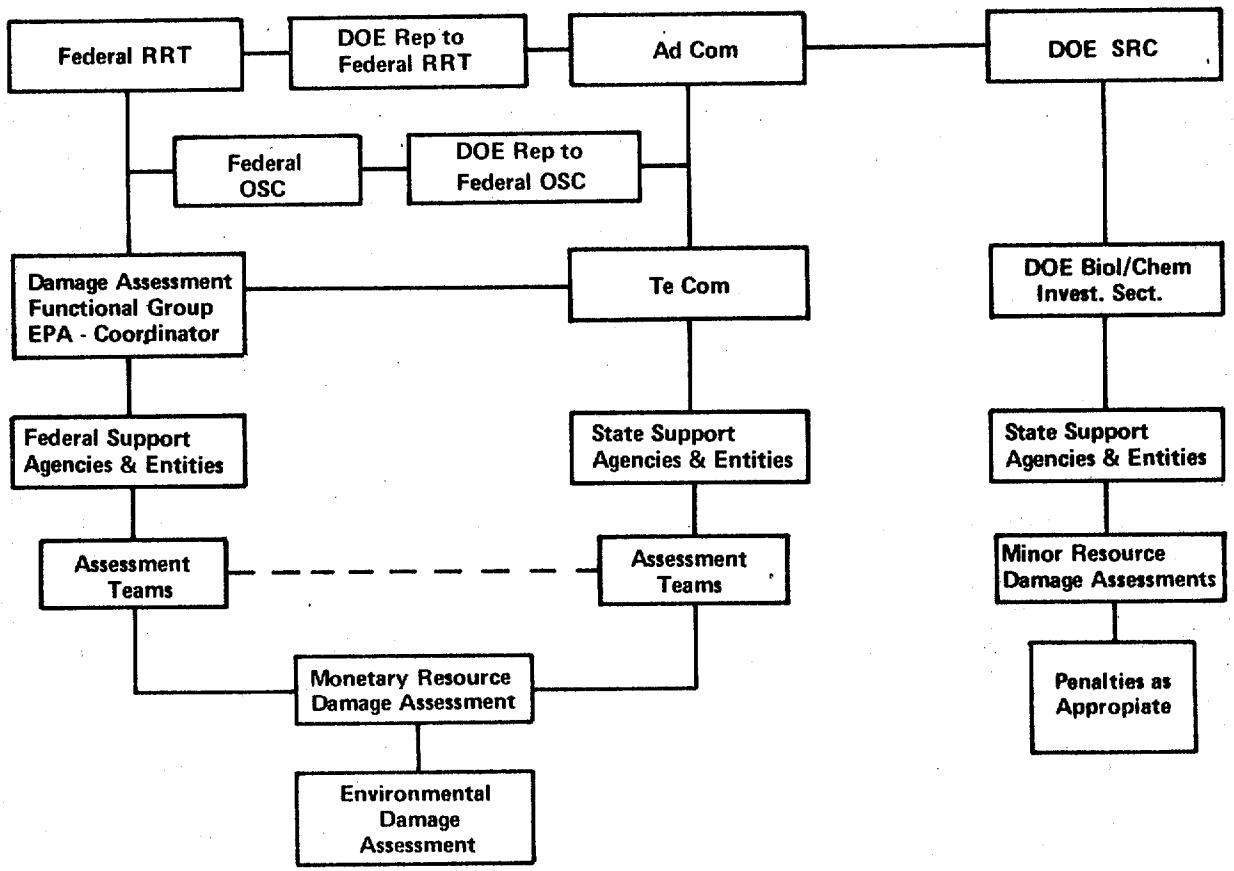


3.3.0 - State/Federal Damage Assessment Coordination

Coordination of the spill response activities of the State of Washington and the federal response agencies occurs through the State Department of Ecology and the Federal Regional Response Team

(RRT). As the state's lead agency in spill response, the DOE is a member of the RRT which is the governing entity of the federal response. The DOE also represents the State of Washington on the staff of the Federal On-Scene Coordinator (OSC) who directs spill response activities on U.S. waters. DOE representatives to these federal teams have assignments on several functional groups including the Scientific Damage Assessment Functional Group. Coordination between the federal response and the MRDA program occurs through the DOE representative on this functional group. Figure 3 demonstrates these lines of communication and coordination:

FIGURE 3. State / Federal Environmental Damage Assessment Coordination



3.4.0 - Scientific Community

The scientific community provides a source of expertise on marine resource damage assessments for both state and federal agencies. During a pollution incident, certain members may serve as consultants and private contractors to state agencies determined by the state agency requiring the assistance or the MRDA committee. Contractors and consultants will be supervised by the contracting officer or by the contracting officer's designee.

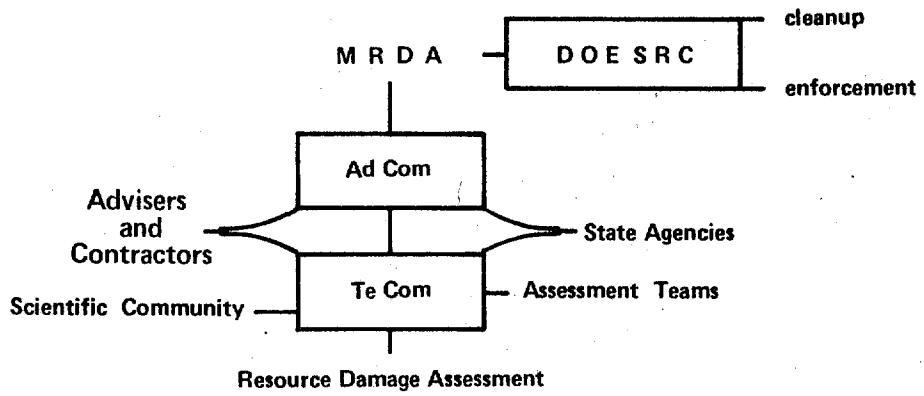
3.5.0 - Volunteers

Volunteers, with or without training and experience will be welcome on the MRDA task force. Volunteers for work on the resource damage assessment will be assigned to agency field teams by TeCom. Volunteers will provide for their own personal gear, food, and lodging. However, transportation will be provided consistent with services provided other members of the response effort.

4.0 - MRDA ADMINISTRATION

MRDA is a Department of Ecology sponsored program designed to organize the state resource management agencies into a task force of marine ecology scientists. In the event of a major type of pollution incident that inflicts damages upon the marine resources of the State of Washington, this task force will respond with the necessary personnel, materials, and equipment and assess those resource damages. The outcome will be a single, comprehensive resource damage assessment compiled by the MRDA committees showing the damages done to the state resources in terms of U.S. dollars. Long-term environmental damage assessments also may be administered through MRDA (Figure 4).

FIGURE 4. M R D A Organization



4.1.0 - Administrative Committee (AdCom)

AdCom is the executive and advisory entity of MRDA. Composed of management personnel from each participating agency, AdCom manages the administrative activities of the damage assessment; i.e., funding, logistics, interagency coordination, etc. AdCom confers with the Governor's Office, the RRT Chairman, state agency directors, the EPA Administrator, etc. An EPA advisor provides federal input to the decision-making processes of AdCom. Members are the agency directors or their appointed representatives.

4.1.1 - Participants

a. DOE, AdCom Chairman

b. WDF

c. WDG

d. DNR

e. DES

f. DSHS

g. P&RC

h. EPA, advisor

4.1.2 - Functions

The AdCom functions as the manager/administrator of the resource damage assessment. The AdCom Chairman will stay in contact with the pollution incident administrators (RRT Chairman, Federal OSC, DOE Spill Coordinator) and keep abreast of the incident progress. AdCom will forward this information to the state agency executives, Governor's Office, etc., as appropriate.

AdCom will support the resource damage assessment effort by administering contracts, seeking project funds and personnel as needed, and ensuring that logistics are adequate. The AdCom functions at the executive level for such needs and support. Requests arise from the field and the technical staff and reach AdCom through TeCom, the Federal Regional Response Team, the On-Scene Coordinator, and the DOE Spill Response Center.

AdCom also is the final reviewer of the monetary resource damage assessment which is prepared by the Damage Assessment Subcommittee. The AdCom chairman's signature will release the monetary damage assessment to the State Attorney General for action.

4.2.0 - Technical Committee (TeCom)

TeCom is the technical coordinating entity of MRDA. Composed of qualified technical supervisory personnel from participating state agencies, TeCom manages the technical aspects of the damage assessment. TeCom is the information link between the damage assessment field teams and the Regional Response and On-Scene Coordinator teams. TeCom also provides resource protection information to the OSC on request. The AdCom/TeCom Damage Assessment Subcommittee prepares the final monetary resource damage assessment.

4.2.1 - Participants

a. DOE, Chairman

b. WDF

c. WDG

d. DNR

e. P&RC

f. DES

g. DSHS

h. Federal advisors: Federal SSC, USFWS, EPA, NOAA, other participating federal agencies

i. Consulting members of the scientific community

4.2.2 - Functions

The TeCom will function as the technical supervisors of the resource damage assessment. The TeCom Chairman will keep in contact with the state agency MRDA coordinators, the scientific functional groups on the OSC's team and the Regional Response Team, EPA, and the DOE Spill Coordinator to keep

abreast of the affected areas, resources damaged, magnitude of damages, and any damage assessments in progress. The TeCom is the technical arm of MRDA working with the scientific community throughout the damage assessment procedure.

4.3.0 - Member Agencies

State agencies that participate in the MRDA program are those agencies that have a management responsibility for one or more of the state's resources (Ecology, Fisheries, Game, Natural Resources, State Parks) -- or that have a responsibility toward the public health and welfare (Social and Health Services) -- or that have a responsibility toward interagency coordination during state responses to disasters (Emergency Services).

4.3.1 - State Agency MRDA Coordinators

Each state participating agency will assign one or more State Agency MRDA Coordinators. State participating agencies may assign the TeCom member as the MRDA Coordinator for their agency. During a damage assessment response, the TeCom member may delegate MRDA Coordinator duties to appropriate personnel within that agency or perform these duties personally. MRDA coordinators will:

a. Maintain an agency response plan complete with personnel assignments, equipment locations, and procedural guidelines.

b. In the event of a resource damage incident, keep abreast of the agency resource damage assessment progress, ensuring that agency procedures follow as closely as possible to MRDA guidelines.

c. Maintain close contact with TeCom serving as the information link between the agency damage assessment response and the overall MRDA effort.

4.4.0 - Assessment Teams

The assessment teams will perform the field investigation following as closely as possible to MRDA guidelines.

4.4.1 - Team Participants

a. Qualified field technical personnel will act as team leaders. Other team members will be drawn from the available personnel of state agencies participating in the damage assessment. Personnel of federal agencies may serve as team members or as team leaders as appropriate.

b. Teams will conduct the resource damage assessment under the direction of the assigned team leader. Each team will prepare an assessment report describing the methods employed, the data collected, and the damages incurred by the resources affected (Section 11.1)(Appendix VIII).

4.5.0 - Consultants

Members of the scientific community may be contracted to provide state agencies with additional expertise during resource damage assessment incidents. State agencies may execute their own contracts with consultants or request consultant assistance through AdCom. Contract requirements will be determined on a case-by-case basis.

4.6.0 - Resource Damage Assessment Subcommittee

4.6.1 - Participants

a. DOE, Chairman;

b. TeCom appointed representatives;

c. AdCom appointed representative; and

d. Consultants as needed.

NOTE: Appointees to the Resource Damage Assessment Subcommittee may be members of a state or federal agency or the private sector.

4.6.2 - Duties

a. Prepare the monetary resource damage assessment from TeCom resource damage assessment data.

b. Submit the monetary damage assessment to AdCom for review and disposition.

5.0 - ALERT AND ACTIVATION PROCEDURES

Alert procedures for MRDA are integrated with the pollution reporting system of the state and federal agencies in Washington State. The mechanics of the reporting system are explained in the *Oil and Hazardous Substances Pollution Contingency Plan for Federal Region 10* and in the Department of Ecology's *Contingency Plan for Spills of Oil and Hazardous Substances*.

5.1.0 - Initiation

Spill reports originating from any source are reported to the National Response Center, USCG, EPA, or DOE. These agencies have commitments to notify each other and other cooperating agencies. For example, the DOE also notifies the state and local government agencies while the USCG notifies EPA, NOAA, USF&WL, and other federal participating agencies.

5.2.0 - Investigation and Classification

The incident is then investigated to:

- Determine the source and cause;
- Estimate the type and quantity of material discharged;
- Classify the incident for the level of response;
- Determine whether negligence or intent was involved for any enforcement action that might follow; and
- Estimate environmental damages.

Other pertinent information regarding the incident also is collected to be passed on during the notification procedure.

5.3.0 - MRDA Alert

The MRDA committees will be alerted automatically upon activation of the DOE Spill Response Center. The DOE Spill Response Center will activate:

- Whenever the Federal RRT activates;
- By executive direction, or
- At the request of the DOE presesignated On-Scene Coordinator (DOE Region Manager).

The MRDA committees will be alerted for significant pollution emergencies in fresh or marine waters and will respond to assess environmental damages statewide.

5.3.1 - MRDA Administrative Committee (AdCom)

Upon activation of the DOE Spill Response Center, the DOE Spill Coordinator (Assistant Director, Office of Operations) will notify the AdCom Chairman. The AdCom Chairman alternates are any member of the AdCom staff. The AdCom person notified will alert the other AdCom members.

5.3.2 - MRDA Technical Committee (TeCom)

The AdCom person notified by the DOE Spill Coordinator also will notify the TeCom Chairman. The TeCom Chairman alternates are any member of the TeCom staff. The TeCom person notified will alert the other TeCom members.

5.3.3 - State Agency Coordinators

The TeCom Chairman or his designee will alert the predesignated state agency MRDA Coordinators. Their alternates are any professional member of the same division that they respectively occupy. State Agency MRDA Coordinators will alert other appropriate members of their agency. In cases where a TeCom member also is the designated MRDA Coordinator, the TeCom member may delegate MRDA Coordinator duties to appropriate agency personnel or undertake agency alert responsibilities.

5.3.4 - MRDA Contractors

MRDA contractors will be alerted by TeCom or the state participating Agency Coordinators whenever it appears that their services may be needed to conduct the resource damage assessment. These notifications will be served as early in the incident as possible.

5.4.0 - MRDA Activation

MRDA activates automatically whenever the DOE Spill Response Center activates. MRDA also will activate:

- At the request of a state government executive;
- At the request of an AdCom member;
- At the request of the Federal Regional Response Team chairman;
- At the request of the On-Scene Coordinator; or
- Whenever extensive environmental damage in fresh or marine waters is apparent.

5.4.1 - AdCom Activation

Upon notification of MRDA activation and upon direction of the AdCom Chairman or the AdCom Chairman's alternate, AdCom members will meet at the DOE Southwest Regional Office conference room, Airdustrial Park, Tumwater, Washington. The AdCom Chairman (alternate) will immediately commence a chronological log of the proceedings and will assume the responsibilities for the administration and management of the resource damage assessment.

5.4.2 - TeCom Activation

Upon notification of MRDA activation the TeCom Chairman or the TeCom Chairman's alternate will immediately make contact with TeCom members to discuss the incident and identify a base of operations for TeCom. Depending upon the location and magnitude of damages, the TeCom may wish to operate locally with AdCom or they may wish to be near the scene. TeCom's first effort will be to commence a chronological log of TeCom activities and assume the responsibilities of the technical supervisor over the resource damage assessment.

5.4.3 - State Agency MRDA Coordinators

Upon notification of MRDA activation, state agency MRDA Coordinators will immediately notify their agency supervisors that a damaging incident has occurred and that MRDA has activated. State agency MRDA Coordinators will assume their responsibility as the primary representative from the state agency to the MRDA TeCom. State agency MRDA Coordinators will request that their respective agencies implement their resource damage assessment plan and immediately commence a chronological log of their activities and the activities of the agency they represent with regard to the resource damage assessment.

5.4.4 - Consultants and Contractors

Upon notification of MRDA activation, MRDA consultants and contractors will make any initial preparations as requested by the notifying agency or committee.

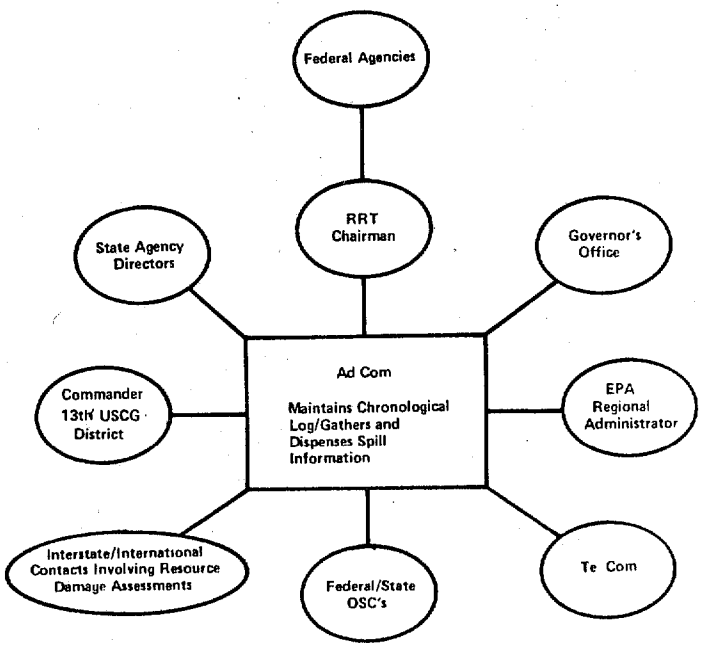
6.0 - DAMAGE ASSESSMENT RESPONSE PROCEDURES

Section 5.0 of this Plan describes the MRDA alert procedures and Section 5.4 describes MRDA activation mechanics. Also, the Department of Ecology's *Contingency Plan for Spills of Oil and Hazardous Substances* and the *Oil and Hazardous Substances Pollution Contingency Plan for Standard Federal Region 10* were referenced to describe the manner in which incident reports are received, processed, investigated, and classified by the involved agencies and how these procedures alert and activate MRDA. This section describes MRDA response procedures which will be administered and managed by AdCom through the AdCom Chairman and technically supervised by the TeCom through the TeCom Chairman. In many cases, MRDA alert and activation procedures and initial response activities will occur simultaneously with spill containment and cleanup activities. Whenever possible, damage assessment field teams will collect pre-impact environmental data for pre- and post-spill comparisons.

6.1.0 - AdCom Response

Once AdCom is activated, the AdCom Chairman or the AdCom Chairman's designee will immediately begin a chronological log of their proceedings and will assume responsiblity for the administration and management of the marine resource damage assessment (Figure 5).

FIGURE 5. Administrative Committee's Communication Schematic during a Resource Damage Assessment Response.



AdCom's first effort will be to gather information on damaged resources from the cleanup project administrators on scene. Close contact will be maintained with the USCG OSC for overflight information regarding the incident. Of immediate interest would be locations and trajectories of contamination, quantity and type of material discharged, weather predictions, plans for containment and cleanup, and locations of observed damages.

The federal Regional Response Team (RRT) Chairman may provide air and water transportation and other logistic assistance for team members, funding for the damage assessment, and additional personnel if the need arises. The RRT chairman will be cognizant of any serious problems confronting the cleanup and monitoring project that may affect the resource damage assessment effort. The RRT chairman also will have an interest regarding the progress of the resource damage assessment.

The AdCom, under the direction of the AdCom Chairman, also will:

a. Act as a medium for information exchange regarding affected resources among all participating agencies and groups.

b. Interact with the Washington State Governor's Office with regard to the environmental damages associated with the pollution incident.

c. Initiate the activation of the state resource damage assessment.

d. Ensure that TeCom and field teams are adequately supported logistically.

e. Seek sources of personnel and funding support for the resource damage assessment as necessary.

f. Make any policy-level decisions that occur with regard to the resource damage assessment.

g. Review and comment on contracts regarding the resource damage assessment.

h. Recommend to the DOE comptroller the use of any funds committed to the resource damage assessment.

i. Review and submit the state's monetary damage assessment to the Attorney General for action; also forward a copy to the EPA regional administrator.

j. Communicate as necessary with state participating agency directors, EPA regional administrator, state Office of Fiscal Management, and other officials representing state, federal, and local government offices and the private sector to expedite the resource damage assessment.

k. Other functions of administrative or management nature as determined during the course of the resource damage assessment.

6.2.0 - TeCom Response

Once TeCom is activated, the TeCom Chairman or his designee will begin a chronological log of their proceedings and will assume responsibility for the technical supervision of the resource damage assessment (Figure 6).

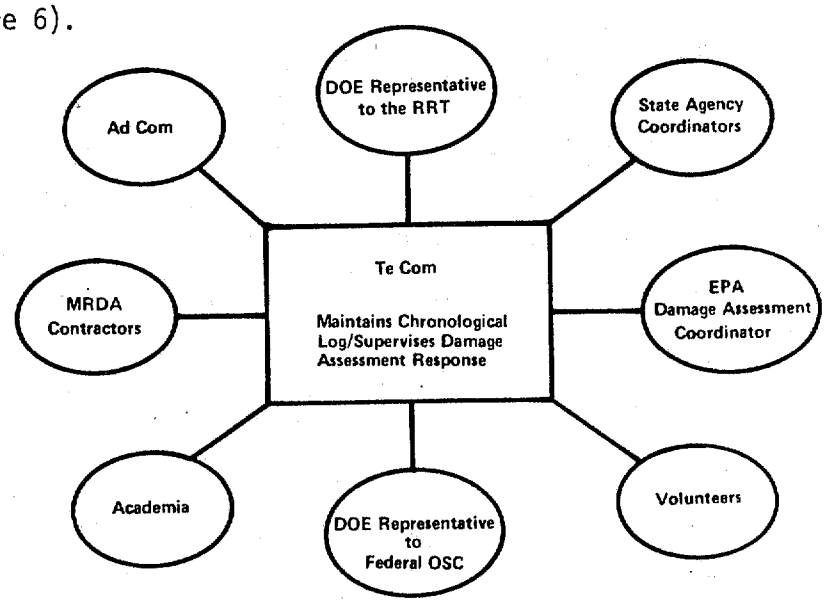


FIGURE 6. Technical Committee's Communication Schematic during a Resource Damage Assessment Response.

TeCom's first effort will be to gather data on damaged resources from state agency MRDA Coordinators, the On-Scene Coordinator, the DOE Spill Coordinator, the Regional Response Team, and EPA. This information will be plotted on charts which will be updated as new information arrives. Resource damage assessments in progress also will be plotted. These data will be passed on to appropriate participating agencies and will be used to deploy damage assessment teams.

Additional TeCom duties are as follows:

a. Make recommendations to AdCom on the necessity and degree of the damage assessment.

b. Initiate the response of participating state agencies as needed through the state agency MRDA Coordinators.

c. Receive and disburse information on damage prediction and trajectory from USCG.

d. Assign assessment priorities as the incident develops.

e. Deploy damage assessment teams to affected locations.

f. Coordinate activities of assessment teams. Coordinate with non-MRDA groups which wish to participate.

g. Collate data for damage assessment purposes.

h. Prepare periodic reports showing progress of the damage assessment. Submit progress reports to AdCom for distribution.

i. Coordinate long-term recovery studies (environmental damage assessment).

j. Maintain a system for receiving and disseminating information to field teams.

k. Prepare news releases on technical matters as appropriate; keep DOE Public Affairs Office informed of progress.

l. Coordinate with technical representatives of the federal On-Scene Coordinator, Regional Response Team, and other federal support groups.

m. Other functions of a technical nature necessary for coordinating the damage assessment activities of the state.

6.3.0 - Resource Damage Assessment Teams

The major MRDA field effort will be through assessment teams deployed by state resource management agencies. The state agency MRDA Coordinators will keep abreast of the field work, the data collection, reduction and analysis, and the monetary damage assessment being accomplished by their respective agencies and forward this information to TeCom for final processing. Requests from state participating agencies for assistance will be processed through the state agency MRDA Coordinator.

The second major effort will be through teams deployed by TeCom. These teams will be composed of volunteers from state, federal, and local government agencies, the academia, the private sector, and the general public. The teams will operate directly with TeCom. The data they collect will be reduced and analyzed by the team and referred to TeCom for final processing.

Other teams may be deployed by NOAA, USFWS, EPA, or other federal agencies. These studies may be directed at biological resources not managed by participating state agencies. Although these teams will not be under state direction, their assessment activities will

be coordinated with the activities of the state assessment teams, and their data will be available to TeCom and the state assessment teams through the MRDA program. Likewise, all data collected by the state assessment teams will be available to the federal assessment teams through the MRDA program.

6.4.0 - Consultants and Contractors

Consultants and contractors may be employed, on a case-by-case basis, whenever additional expertise is required. Consultants and contractors may be hired through MRDA (DOE managed funds), or by individual agencies, consistent with available funding.

7.0 - LOGISTICS/COMMITMENTS

Activation of state agencies will be dependent upon resources affected and ability to respond. Requests for equipment and personnel from non-activated agencies will be processed through AdCom. Guidelines for field operations of federal agencies are provided in the National Contingency Plan and the Federal Region X Contingency Plan. Guidelines for assessment of damages to the resources of Washington State are found in the appendices of this document (Appendix VIII).

7.1.0 - State Agencies

7.1.1 - Department of Ecology (DOE)

DOE maintains a store of field equipment and vehicles for use during MRDA activities and will provide field personnel including four to six state-certified SCUBA divers. DOE field or field-related activities will include, but are not limited to the following:

a. Establish and maintain a meeting location for AdCom and TeCom and provide communications facilities and technical supplies for both teams;

b. Chair the TeCom;

c. Chair the AdCom;

d. Perform water quality, sediment, and tissue sampling, (pre- and post-impact);

e. Provide for analytical services for determining contamination by hydrocarbons or other pollution components (water, soil, and tissues);

f. Investigate the incident to identify the violator, cause and whether or not negligence or intent was involved in the discharge. Initiate enforcement actions as appropriate.

g. Provide baseline data to TeCom;

h. Provide a public affairs information center;

i. Perform damage assessments for freshwater streams or lakes that may be affected (Tracy and Bernhardt, 1974);

j. Pursue recovery of the damage assessment claim through the State Attorney General;

k. Arrange services for tainting studies; and

l. Assess damages to private property upon request as last priority.

7.1.2. - Department of Fisheries (WDF)

WDF, when activated, will provide equipment and personnel including certified state divers. WDF field or field-related activities may include, but are not limited to the following:

a. Provide a state agency MRDA Coordinator;

b. Participate in AdCom and TeCom;

c. Assess damages to:

- affected nearshore fishes
- affected shellfish beds
- affected food fish populations
- significantly affected intertidal and subtidal habitats

- affected shoreline properties and physical facilities owned or managed by WDF
- affected nursery habitats utilized by juvenile food fishes;

d. Monitor recovery of affected resources;

e. Upon request of TeCom, assess biological resources not under WDF jurisdiction according to the operating limitations of WDF; and

f. Assess damages to private property upon request as last priority.

7.1.3. - Department of Natural Resources (DNR)

DNR, when activated, will provide equipment and field personnel. DNR field or field-related activities may include, but are not limited to the following:

a. Provide a state agency MRDA Coordinator;

b. Participate in AdCom and TeCom;

c. Assess damages to:

- affected shoreline property owned or managed by DNR in cooperation with the WDF
- affected physical public facilities owned or managed by DNR
- affected marine plants
- affected beds of U.S. waters in cooperation with the WDF;

d. Monitor recovery of affected resources if necessary; and

e. Assess damages to private property upon request as last priority.

7.1.4 - Department of Game (WDG)

WDG, when activated, will provide equipment and field personnel. WDG field or field-related activities may include, but are not limited to the following:

a. Provide a state agency MRDA Coordinator;

b. Participate in AdCom and TeCom;

c. Assess damages to:

- all affected bird populations
- affected marine mammal and aquatic furbearer populations
- affected migratory game fish and resident non-game fish populations
- affected game and non-game animals inhabiting affected shorelines
- affected wildilfe habitats
- affected physical facilities owned or managed by WDG
- affected shorline properties owned or managed by WDG in cooperation with WDF

d. Monitor long-term effects and recovery of affected resources; and

e. Assess damages to private property upon request as last priority.

7.1.5 - Parks and Recreation Commission (P&RC)

P&RC, when activated, will provide equipment and personnel for field activities. P&RC field and field-related activities may include, but are not limited to the following:

a. Provide a state agency MRDA Coordinator;

b. Participate in AdCom and TeCom;

c. Assess damages to:

- affected shorelines of parks and related physical facilities in cooperation with the WDF
- affected shoreline properties of non-park status owned or managed by P&RC in cooperation with the WDF.

7.1.6 - Department of Social and Health Services (DSHS)

DSHS, when activated, will provide equipment and personnel for public health investigations. DSHS field or field-related activities may include, but are not limited to the following:

a. Provide a state agency MRDA Coordinator;

b. Participate in AdCom and TeCom;

c. Investigate public health hazards;

d. Implement closures and reopenings of affected lands or fisheries whenever a public health hazard is identified; and

e. Provide services for analytical research in the area of public health.

7.1.7 - Department of Emergency Services (DES)

DES field or field-related activities will include, but are not limited to the following:

a. Provide a state agency MRDA Coordinator;

b. Participate in AdCom;

c. Serve as advisors to TeCom; and

d. Coordinate MRDA activities with local civil authorities within the affected region.

7.2.0 - Federal Agencies

7.2.1 - Environmental Protection Agency (EPA)

EPA will provide equipment and as many field people as can be utilized effectively, either in meeting EPA needs or in filling emergency field manpower needs of other state or federal agencies. EPA field or field-related activities will include, but are not to be limited to the following:

a. Collect and analyze water, sediment, and biota samples from impact and control areas (coordinated with DOE);

b. Determine damage assessment needs relative to noneconomically important marine biota including the subsequent pursuit of scientific expertise and funding to conduct the required damage assessment;

c. Provide EPA public affairs (news) coverage; and

d. Assist in producing a combined state/federal damage assessment report.

7.2.2 - U.S. Fish and Wildlife Service (USFWS)

USFWS will provide field equipment and personnel necessary for the performance of an impact assessment on affected fish

and wildlife resources. Field or field-related activities will include, but are not to be limited to the following:

a. Perform autopsies and chemical analyses of sea birds and fish;

b. Supply expert personnel (sea bird and marine fish biologists) to assist state agencies;

c. Supply personnel and equipment for beach walks and aerial surveys;

d. Supervise volunteer groups involved in cleaning sea birds and provide data on species affected, survival, and mortality rates;

e. Assist in law enforcement;

f. Assist in establishing dollar values for affected bird species; and

g. Help with funding contracts for the purpose of long-term monitoring of affected sea bird populations.

7.2.3 - National Oceanic and Atmospheric Administration (NOAA)

NOAA, through its branch services, will provide personnel and equipment consistent with its duties as described in Section 2.2.4:

(1) Provide scientific expertise on living marine resources for which it is responsible;

(2) Coordinate scientific support in coastal areas;

(3) Provide current and predicted meteorological, hydrologic, ice conditions and oceanographic conditions for the high seas, coastal, and inland waters;

(4) Provide charts and tide/current information for coastal and territorial waters; and

(5) Assist EPA in damage assessment in coastal regions and on the high seas.

7.2.4 - Other Federal Agencies

Activities of other federal agencies which may be involved in damage assessment activities are dependent upon the requirements of the federal damage assessment functional group.

8.0 - DAMAGE ASSESSMENT SCOPE

Under RCW 90.48.142, anyone who unlawfully discharges a harmful substance into a body of water "and in the course thereof causes the death of, or injury to, fish, animals, vegetation, or other resources of the state, or otherwise causes a reduction in the quality of the state's waters below the standards set by the commission, thereby damaging the same, shall be liable to pay the state damages in an amount equal to the sum of money necessary to restock such waters, replenish such resources, and otherwise restore the stream, lake, or other water source to its condition prior to the injury..." Restocking costs include the cost of restocking the number of organisms killed plus the cost of an additional percentage to cover stocking and natural mortalities plus the cost of labor in restocking. Costs involved to replenish such resources include monetary loss to the fishery and the reproductive segment of the population. These losses may involve more than one life cycle. Restore the water source would include all costs that would be involved in returning the affected area to its pre-injury state. Damages to the physical, biological, and economic resources of the affected area would be assessed under the restoration clause (Sections 8.1.0 to 8.3.0).

In addition to damages to public resources, the violator also is liable for damages to privately owned lands, facilities, and enterprises within the affected area. Recovery of monetary damages for resources under private ownership must be pursued through civil court actions by the injured party(ies).

8.1.0 - Physical Parameters

The WDF, WDG, DNR, and P&RC maintain a number of structural facilities in the coastal waters of Washington State for use by the public or for use by the agencies in managing the resources under agency jurisdiction. These include, but are not limited to:

a. Boat launches;

b. Boat docks and public piers;

c. Navigational and mooring buoys;

d. Beach facilities; and

e. Underwater parks and reefs.

8.2.0 - Biological Parameters

The biological parameters include all living plants and animals inhabiting the waters of the state, their habitats and food resources, and the environment in which they live. Under RCW 90.48.142, the violator is liable for damages to any or all biological parameters. However, monetary and personnel constraints put limitations on the number of organisms and other environmental parameters that can be included in a monetary damage assessment. Therefore, the initial monetary damage assessment will focus on organisms for which monetary values can be established. These include but are not limited to the following:

a. Food Fish (Stokes, 1979)(Appendix XI)

1. *Scorpaenidae* (Rock fishes)

2. *Pleuronectidae* (Flounders)

3. *Squalidae* (Dogfish)

4. *Bothidae* (Sanddabs)

5. *Embiotocidae* (Surfperches)

6. *Hexagrammidae* (Ling cod and Greenlings)

7. *Cottidae* (Sculpins)

8. *Gadidae* (Cod fishes and Hake)

9. *Osmeridae* (Smelts)

10. *Clupeidae* (Herring)

11. *Salmonidae* (all salmon species)

12. Other species when monetary values are established.

b. Game Fish (Stokes, 1979)(Appendix XI)

1. *Salmonidae* (migratory trouts)

c. Shellfish (Stokes, 1979)(Appendix XI)

1. Crabs

2. Oysters

3. Clams and Cockles

4. Mussels

5. Shrimps

6. Squids and octopi

7. Other species when monetary values are established.

d. Birds (Appendix XI)

1. All species utilizing affected waters

e. Mammals (Appendix XI)

1. Whales, dolphins, porpoises

2. Seals and sea lions

3. Sea otters

4. Shoreline inhabitants

a) Raccoons

b) River otter and other fur bearing game species

c) Other game and non-game animals.

f. Habitat Restoration

1. Nesting areas for marine birds

2. Haulouts and calving grounds for seals and sea lions

3. Marshes

4. Kelp beds

5. Any restoration procedures for rock, sand, mud, or mixed shorelines.

g. Environment (Appendix XI)

1. Food chain organisms

a) Phyto and zoo plankton

b) Eggs and larval fishes

c) Algae and detritus

A long-term environmental damage assessment may be conducted if personnel and funding is available. The violator also would be liable for any additional damages detected in the long-term study.

8.3.0 - Economic Parameters

Economic parameters include all reductions in state revenues incurred through loss of tax revenues and license and fee revenues normally generated by the affected resources (Sections 9.2.0 and 9.4.0).

9.0 - VIOLATORS' LIABILITIES

Under RCW 90.48.142 (Appendix II) and applicable federal statutes, any person(s) who unlawfully discharges a substance into the waters of Washington State is liable for any damages to the biological, physical, and economic resources of the state. The discharger's liabilities may include, but are not limited to the following:

9.1.0 - Biological Liabilities

a. The monetary value of all organisms killed or subsequently lost due to injury and loss of habitat (Appendices VIII and IX);

b. Cost of rearing and restocking such organisms and replenishing the resource to pre-discharge level; and

c. Any fines or punishments for killing or injuring a protected species as specified by public law (Endangered Species Act, Marine Mammal Protection Act, and other relevant state and federal laws).

9.2.0 - Economic Liabilities

a. Loss of tax revenue normally generated by a commercial venture such as a fishery due to the direct loss of the resource caused by the pollution incident;

b. Loss of tax revenue normally generated by a commercial venture while the resource is recovering;

c. Loss of tax revenue normally generated by a commercial venture through inability to utilize an affected resource due to toxic

contamination or tainting (off-taste or objectionable odor) of consumable flesh;

d. Loss of revenue from fees and licenses normally generated by commercial ventures affected by the pollution incident;

e. Loss of tax revenue normally generated by private enterprises affected by the pollution incident; and

f. All state revenue loss, whether direct or indirect, resulting from:

   1. Reduction of public use of affected beaches and parks;

   2. Reduction in recreational activities such as boating, diving, and skiing;

   3. Reduction in fishing, hunting, or other harvest activities; and

   4. Idle capitol equipment and investment loss.

9.3.0 - Physical Liabilities

a. Cost of restoring habitats to pre-discharge condition;

b. Cleanup and repair or replacement of public facilities;

c. Operating costs of equipment needed to clean up and repair public facilities;

d. Acquisition or rental of any special equipment needed to clean up and repair public facilities; and

e. Cleanup or repair to equipment used in accomplishing the above.

9.4.0 - Assessment Costs

a. All costs incurred by the state in performing the damage assessment including costs of personnel, transportation, laboratory analyses, and legal fees.

10.0 - DAMAGE ASSESSMENT DOCUMENTATION

10.1.0 - Forensic Documentation

To prove the resource damage liability of the discharger, the chemical nature and source of the pollutant must be identified; contamination of the water, sediments, or organisms by the pollutant must be established; and the ability of the pollutant to cause observed perturbation of the affected organisms must be confirmed.

10.1.1 - Chemical Identification and Source Determination

Chemical identification and source determination will be accomplished using gas chromatography or other analytical techniques with proven sensitivities equal to or surpassing gas chromatography. Chemical analyses of water, sediment, and tissue samples from affected and non-affected areas will be compared to chemical samples acquired from all suspected pollutant sources for contamination confirmation purposes. Analysis methodologies must conform to EPA approved methods or standard methods.

10.1.2 - Bioassay Confirmation of Perturbation

Bioassays utilizing scientifically approved techniques will be performed by MRDA approved investigators. Water and sediment samples from the affected areas and chemical samples from the pollutant source will be bioassayed utilizing test organisms of a species found within the affected areas.

10.2.0 - Damage Documentation

10.2.1 - Physical

Physical damages will be documented with photographs and witness testimony.

10.2.2 - Biological

Biological damages for each economically important species will be documented by body counts and by sample comparison of their abundances (density and biomass) in the affected areas to their abundances in unaffected areas (control areas). Whenever possible, species composition and densities of the affected organism will be compared to DOE baseline habitats (Gardner 1978; Appendix X, C and D). Long-term damages will be documented by monitoring the affected areas using MRDA approved biological sampling techniques and comparing results to baseline data and data collected from established control areas (Appendix VIII).

10.2.3 - Economic

a. Recreation

Economic damages to state property will be determined from loss of projected revenue in the form of decrease in fees collected for licenses, camping, or other utilization of the affected areas; from loss of sales tax on sales of materials, equipment, and shelter which would have occurred but for the damage to the resources; and from any other recreational losses to the public relating directly to the incident.

b. Commercial

Documentation of damage to commercial finfish and shellfish fisheries will include body counts (if available), landing counts, loss of projected revenue from licensing, loss of projected revenue as a result of closure of a fishery, loss of projected revenue resulting from decreased harvesting while the fishery is recovering. Revenue loss will be calculated from best projections using past revenue collection data as a baseline.

10.3.0 - Damage Claims

Each resource will be assessed by the agency with managerial jurisdiction of the resource. DOE will be responsible for compiling a comprehensive monetary damage assessment claim against the violator. The comprehensive claim will then be turned over to the AdCom for submission to the State Attorney General for recovery action.

11.0 - REPORT WRITING

The investigation reports prepared by team leaders and the final agency reports are the foundation for the state's comprehensive damage assessment and for any civil action which the state may pursue against the violator. If the reports are incomplete and the findings are not well documented, the case may be dropped for lack of evidence. Investigation reports must be concise, answer the who, what, why, where, when, and how questions, and be supported by documentation, statements of witnesses, and photographs. These reports must be clearly written and neatly typed for presentation in court.

11.1.0 - Field Team Assessment Reports

Each team leader should submit a preliminary report to TeCom within 90 days from the initiation of damage assessment investigations. The final report should be ready within 45 days of termination of damage assessment investigations by his team. If assessment activities are of short duration (less than 45 days) progress reports (Section 11.1.1) may substitute for the preliminary report.

11.1.1 - Reporting Periods

During the first 90 days each team leader should prepare a brief progress report for TeCom describing the activities of the team on a weekly basis. After 90 days, progress reports should be prepared on a bi-weekly or monthly basis.

11.1.2 - Recommended Formats

Recommended formats may be changed with TeCom approval.

a. Intra-agency Reports

Any report written for use within a participating agency will be in the format designated by the agency.

b. Progress Reports

Progress reports may be copies of intra-agency reports or memorandums to the TeCom Coordinator.

c. Preliminary Report

1. Introduction

The introduction should describe the resource being investigated, the areas involved, type of pollutant, dates, and other background information.

2. Summary

Briefly summarize the findings of the investigation to date.

3. Methods and Procedures

Briefly describe the investigative procedures being used, including formulas used for calculating losses.

4. Findings of Fact

Next in order should be a brief statement of each fact that occurred regarding the incident beginning from the moment the incident was reported to the team. The resulting numerical list of statements should show each move the investigating team made

during the investigation and each fact that was learned while investigating the incident. Do not include results of scientific sampling. This information should be presented in chronological order and should include times, dates, names, addresses, and phone numbers of contacts, and any other information pertinent to the investigation.

5. Results and Discussion

Briefly discuss the results of the scientific investigation and other pertinent information. Appropriate subheadings should be used to identify resources or environmental parameters under investigation.

6. Recommendations

Describe briefly any field conditions encountered during the field investigation requiring alterations in recommended procedures and any recommendations for permanent change in investigative procedures.

7. Appendices

Copies of the raw data, calculations, photographs, and other pertinent material should be included in appendices.

d. Final Report

1. Title page

2. Summary

Summarize the findings of the field investigation.

3. Introduction

Same as for preliminary report.

4. Findings of Fact

Same as for preliminary report.

5. Methods and Materials

Describe the investigative procedures and materials used during the investigation.

6. Results

Analysis of data, relevant tables and graphs, and observations. This section should be presented under subheadings. Example: Substrate; Water Chemistry; Flora; Shellfish; Laboratory Analysis; etc.

7. Discussion

Describe what was found, causes, interpretation of data (literature citations), new findings, and other relevant material.

8. Recommendations

Describe unusual or unexpected field conditions encountered during the investigation and make recommendations for improving field investigation in future incidents.

9. Literature Cited

Only publications cited in report.

10. Appendices

The appendices should contain the miscellaneous information and material that supports the case, all of which may or may not be referenced from the text. If only one appendix is used, the following order of presentation is recommended:

a) Unprocessed Data. Xerox copies of field and laboratory notebooks and work sheets. This must be included.

b) List of Witnesses. List each witness separately including his name, address, phone number, and where he can be readily contacted.

c) Witness Statements. Statements of witnesses shall be attached together.

d) List of Samples. List the samples taken, where they were extracted, type of material, and where they are stored (see Appendix VIII 1. of this document).

e) Memoranda and Correspondence. Any memoranda and correspondence regarding the incident from the entities involved or from the agency to the entities involved should be included here.

f) Cleanup Project. Any reports or memoranda describing the impact of the cleanup project may be included here.

g) Reports from other Agencies. Reports from other agencies describing their input with respect to the incident or the impacts of the incident on their area of responsibility may be attached here.

h) Maps and Charts. Maps and charts showing the affected area are extremely important.

i) Special Criteria. Blueprints, schematics, and other drawings are helpful in understanding the mechanics of the case.

j) Photographs. Photographs are very important supportive evidence and shall be attached last.

11.2.0 - Agency Reports

Within 90 days of the termination of the agency's damage assessment activities, the agency will submit a final impact assessment report pertaining to the resources under agency jurisdiction to TeCom.

11.2.1 - Recommended Format

a. Final Report

1. Title Page

2. Summary and Conclusions

Briefly summarize the damage to the resources under jurisdiction of the agency and the implications for the future of the resources.

3. Introduction

Include only background information on the agency's participation in the state's damage assessment activities.

4. Methods and Procedures

   Discussion on the methods used to establish values on affected resources.

5. Impact on Resource(s)

   Analysis of data with respect to impact on resources. Use appropriate subheadings.

6. Discussion

   Describe impact of incident on current and future utilization and management of resources.

7. Recommendations

   Recommend economic values to be used in assessing monetary damage to resource, recommendations for follow-up studies or long-term monitoring, including costs, and recommendations for future assessment procedures. Use appropriate subheadings.

8. Literature Cited

   Only literature cited in the report.

9. Appendices

   Include an itemized list of costs incurred during the damage assessment and documentation thereof, any miscellaneous material supporting the text, and all official forms required by TeCom or enforcement agencies.

11.3.0 - Agency Follow-up Reports

When recovery studies or monitoring programs are initiated either by an agency or through private contractors, the agency with jurisdiction over the resource should submit reports to TeCom on a quarterly or semi-annual basis. Other time periods may be used if more appropriate.

11.3.1 - Recommended Format

a. Progress Report

Progress reports should be in the form of a memorandum from the agency director or his appointee to the TeCom Chairman.

b. Final Report

If subsequent civil action by the state is recommended, the final report should follow the form recommended for Agency Reports. If no action is proposed and the report is for agency use only, a copy of the report submitted to the TeCom Chairman is sufficient.

11.4.0 - TeCom Reports

TeCom reports to state agencies will be memorandums to appropriate personnel with copies to the agency director, if appropriate, or follow formats provided by the DOE.

TeCom reports to federal agencies will be memorandums to appropriate personnel or follow formats provided by federal agencies.

APPENDICES

APPENDIX I

MRDA PARTICIPANTS
(Names and Telephone Numbers)

			Work Phone	Home Phone
A.	EMERGENCY NUMBERS			
	1.	DOE (206) 753-2353		
	2.	EPA (206) 442-1263		
B.	AdCom			
	1. DES	James Thomas	(206) 753-5255	(206) 491-2061
	2. DOE	Randy Fisher (Chairman)	(206) 753-6872	(206) 352-3169
	3. DNR	Bill A. Johnson	(206) 753-5326	(206) 491-3025
	4. DSHS	Carl Sagerser	(206) 753-5961	(206) 491-3096
	5. P&RC	Jan Tveten	(206) 753-5757	(206) 273-9379
	6. WDF	Bill Rees	(206) 753-3621	(206) 459-2051
	7. WDG	Fred Holm	(206) 753-2901	(206) 491-7086
	8.	EPA - EMERGENCY RESPONSE - (206) 442-1263		
C.	TeCom			
	1. DES	Gordon Goff	(206) 753-5255	(206) 491-3354
	2. DOE	Fred Gardner	(206) 753-0577	(206) 752-9689
	3. DNR	Doug Magoon	(206) 753-3703	(206) 943-0394
	4. DSHS	Max Hays	(206) 753-5959	(206) 491-3794
	5. P&RC	Dave Heiser	(206) 753-2016	(206) 357-5117
	6. WDF	Earl Finn	(206) 753-3629	(206) 456-1576
	7. WDG	Fred Holm	(206) 753-2901	(206) 491-7086
	8.	EPA - EMERGENCY RESPONSE - (206) 442-1263		
	9.	USFWS - Olympia Area Office - (206) 753-9578		
	10. NOAA	MESA	(206) 442-5590	

D. AGENCY COORDINATORS

			Work Phone	Home Phone
1.	DES	Gordon Goff	(206) 753-5255	(206) 491-3354
2.	DOE	Fred Gardner	(206) 753-0577	(206) 752-9689
3.	DNR	Rick Vining	(206) 753-3703	(206) 943-8954
4.	DSHS	Max Hays	(206) 753-5959	(206) 491-3794
5.	P&RC	Bill Bush	(206) 753-2017	(206) 491-2326
6.	WDF	Earl Finn	(206) 753-3629	(206) 456-1576
7.	WDG	Fred Holm	(206) 753-2901	(206) 491-7086
	Alternate -	Jim DeShazo	(206) 753-2895	(206) 456-2407
8.	EPA	John Sainsbury	(206) 442-1263	(206) 743-2010
9.	USFWS	Randall Smith	(503) 231-6229	(503) 636-7946
10.	NOAA	Howard Harris (NOAA Contact)	(206) 442-5590	--
11.	USCG	Captain of the Port		
		Seattle, Washington	(206) 442-1856, (206) 442-7070 after hours	
		Portland, Oregon	(503) 221-6323, (503) 221-6323 after hours	
12.	DES		(206) 753-5990	

APPENDIX II

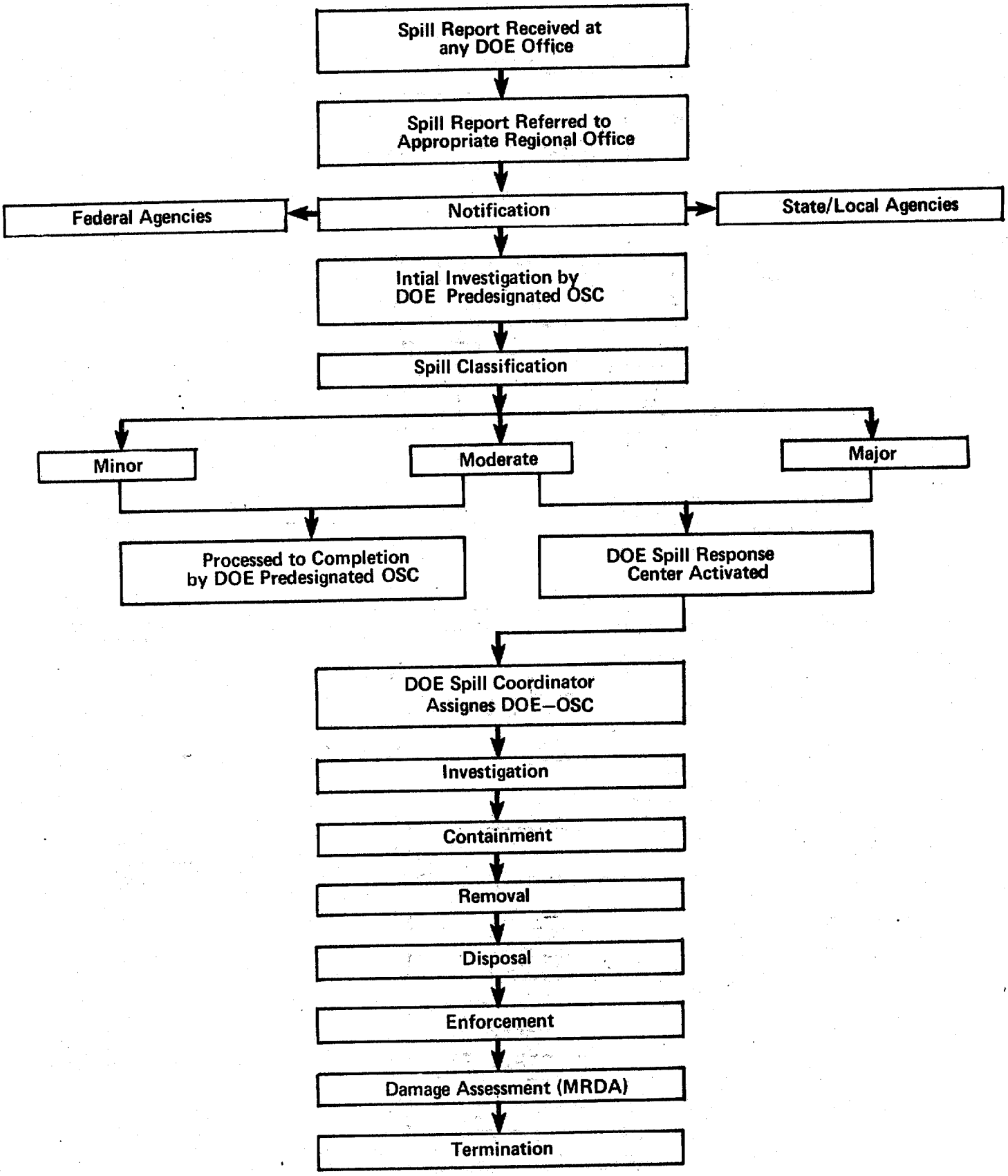
LIABILITY FOR RESOURCE DAMAGES

RCW 90.48.142 Violations--Liability in damages for injury or death of fish, animals, vegetation--Action to recover. Any person who violates any of the provisions of this chapter, or fails to perform any duty imposed by this chapter, or violates an order or other determination of the commission or the director made pursuant to the provisions of this chapter, including the conditions of a waste discharge permit issued pursuant to RCW 90.48.160, and in the course thereof causes the death of, or injury to, fish, animals, vegetation or other resources of the state, or otherwise causes a reduction in the quality of the state's waters below the standards set by the commission, thereby damaging the same, shall be liable to pay the state damages in an amount equal to the sum of money necessary to restock such waters, replenish such resources, and otherwise restore the stream, lake or other water source to its condition prior to the injury, as such condition is determined by the commission. Such damages shall be recoverable in an action brought by the attorney general on behalf of the people of the state of Washington in the superior court of the county in which such damages occurred: Provided, That if damages occurred in more than one county the attorney general may bring action in any of the counties where the damages occurred. Any money so recovered by the attorney general shall be transferred to either the state game fund or the department of fisheries to use for food fish or shellfish management purposes and propagation, or to any other agency of the state having jurisdiction over the resource damaged and for which said moneys were recovered, as appropriate: Provided, That the agency receiving such money shall utilize not less than one-half of said money on activities or projects within the county where the action was brought by the attorney general. No action shall be authorized under this section against any person operating in compliance with the conditions of a waste discharge permit issued pursuant to RCW 90.48.160. [1970 ex.s. c 88 § 12; 1967 ex.s. c 139 § 13.]

Severability---1967 ex.s. c 139: See RCW 82.34.900.

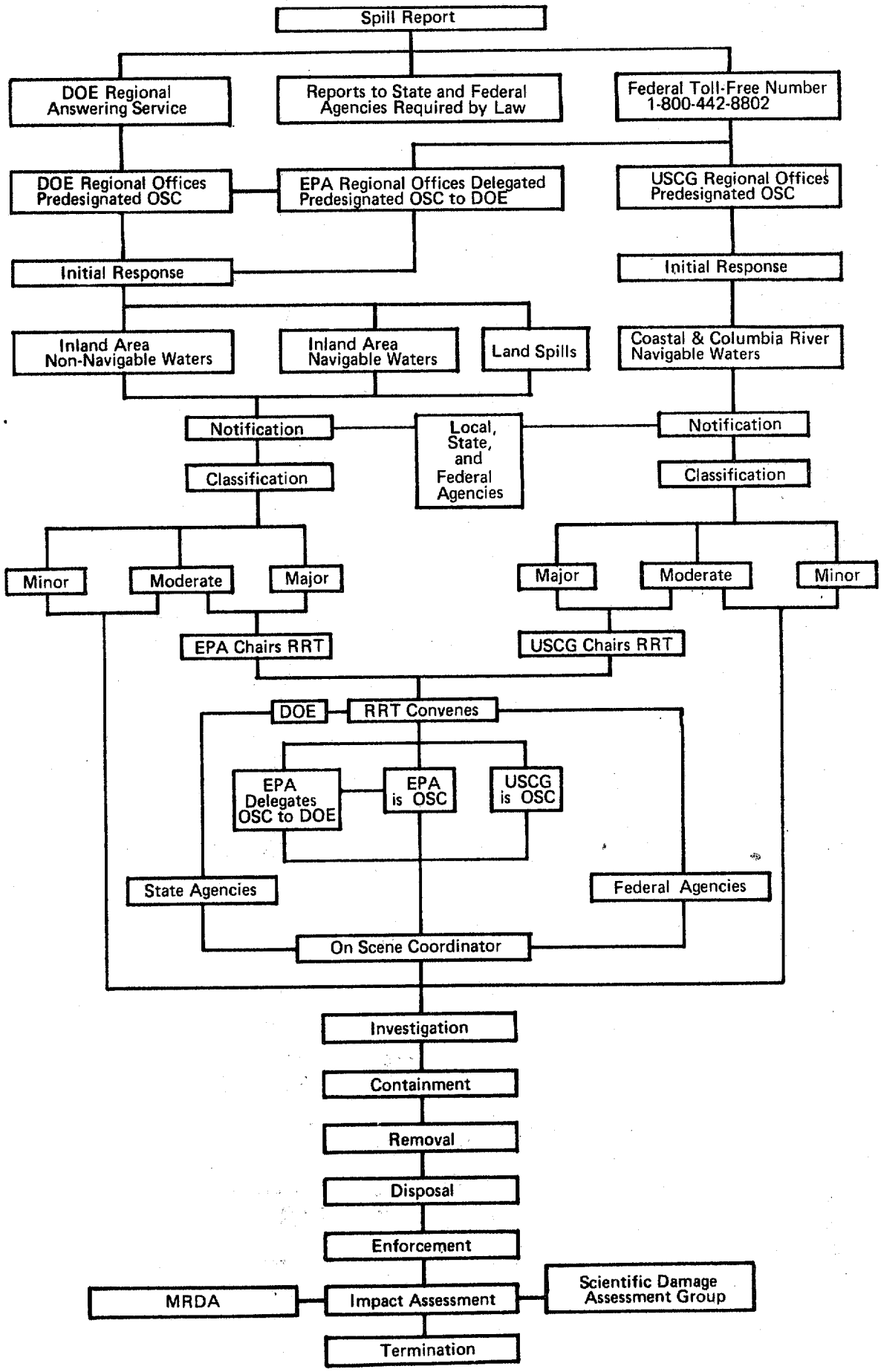
APPENDIX III

Doe Inhouse Response to Spills of Oil and Hazardous Substances



APPENDIX III

Oil and Hazardous Substances Spill Response in Washington State Waters



APPENDIX IV

PUBLIC AFFAIRS

During an oil or hazardous substances spill emergency, the DOE Public Affairs Office will initiate all official news releases regarding the containment, removal, enforcement actions, and damages resulting from the incident. Information for release will be provided by the DOE Spill Coordinator. The Public Affairs Officer will make every effort to coordinate news releases with other agencies including the On-Scene Coordinator and the Regional Response Team. Individuals seeking spill information will be referred to the DOE Spill Coordinator.

APPENDIX VI

FUNDING

No special fund is maintained to pay for marine resource damage assessments. However, during a pollution emergency, funds will become available from one or more sources: (1) The violator; (2) federal agencies; (3) the Governor's emergency fund; or (4) state agencies. State and federal laws state that expenses incurred by governmental agencies will be reimbursed by the violator. There may be delays in reimbursement if the case goes through the courts.

APPENDIX VII

CONSULTANTS, CONTRACTORS, SERVICE ORGANIZATIONS

A. Consultants and State Experts for Biological Sampling

1. Benthic Infauna - Epifauna

Carl Nyblade, Department of Zoology, University of Washington,
Seattle WA 98192
(206) 378-2384 (Friday Harbor)

Bert Webber, Huxley College of Environmental Studies,
Western Washington University, Bellingham WA 98225
(206) 532-3509

Ken Chew, College of Fisheries, University of Washington,
Seattle WA 98195
(206) 543-4270

Tom English, Oceanography, University of Washington,
Seattle WA 98195
(206) 543-5077

2. Marine Fish - Epibenthic Invertebrates

Bruce Miller, College of Fisheries, University of Washington,
Seattle WA 98195
(206) 543-2135

Peter B. Bergman, Assistant Director, Salmon Program
State Department of Fisheries
Olympia WA 98504
(206) 753-6631

Rick Cardwell, Envirosphere Co.
10800 N.E. 8th Ave., Room 715
Bellevue WA 98004
(206) 453-6046

Gene DiDonato, Assistant Director, Marine Fish Program
State Department of Fisheries
Olympia WA 98504
(206) 753-6716

Charles Simenstad, Fisheries Research Institute
University of Washington
Seattle WA 98195
(206) 543-7185,-4650

3. Shellfish

Ron Westley, State Department of Fisheries
Olympia WA 98504
(206) 753-6749

4. Algae

Thomas Mumsford, Department of Natural Resources,
Olympia WA 98504
(206) 753-3703

Ron Phillips, Seattle Pacific University,
Seattle WA 98101
(206) 231-2203

5. Fate and Effects

Dick Vanderhorst, Charles Gibson, and Jack Anderson,
Battelle Pacific N.W. Labs, Route 5, Box 1000,
Sequim WA 98302
(206) 683-4151

Charles Woelke, State Department of Fisheries
Olympia WA 98504
(206) 753-6635

Robert Clark, National Marine Fisheries Service
2725 Montlake Boulevard East
Seattle WA 98112
(206) 442-5569

6. Birds

Gordon Alcorn, University of Puget Sound, 1500 North Warner,
Tacoma WA 98406
(206) 756-3121

David Manuwel, University of Washington
Seattle WA 98195
(206) 543-1585

Lora Leschner, State Department of Game, 600 N. Capitol Way,
Olympia WA 98504
(206) 754-1449

Steve Herrman, Lab 1, The Evergreen State College,
Olympia WA 98505
(206) 866-6063

Terence Wahl
3041 Eldridge
Bellingham WA 98225
(206) 733-8255

7. Marine Mammals

Al Erickson, College of Fisheries, University of Washington, Seattle WA 98195

Steve Jeffries, University of Puget Sound, 1500 North Warner, Tacoma WA 98406

Bruce Mate, Oregon State University, Newport Laboratory, Corvallis OR 97330

Robert Everitt, State Department of Game, 606 N. Capitol Way, Olympia WA 98504
(206) 754-1449 or (503) 325-8241

B. Laboratory Services

Cooperative Fishery Research Unit, College of Fisheries WH 10, University of Washington,
Seattle WA 98195

National Fisheries Research Center
Seattle WA
(Fate and effects of hydrocarbons in the environment)

National Wildlife Health Lab
Madison WI
(toxicology)

Columbia National Fisheries Research Lab (CNRFL)
Columbia, Missouri
(toxicology)

National Wildlife Research Center
Patuxent MD
(toxicology)

National Analytical Facility
National Marine Fisheries Service
Seattle WA
(chemical extraction and analyses)

C. Service Organizations

Seattle Wild Bird Clinic
Seattle WA
(care of affected birds)
(206) 824-6249

Oceanographic Institute of Washington
Seattle WA
(206) 464-6272

APPENDIX VIII

FIELD ASSESSMENT TECHNIQUES

INTRODUCTION

The complex and dynamic nature of the marine ecosystem, prevailing weather, time of year, location and habitat variability, currents, type and amount of pollutant, and methods of cleanup interact to affect the extent and magnitude of damage to the environment. The present state of the art for determining pollutant-caused environmental damage, although often underestimating damages, does provide researchers with the capability of producing an approximate damage assessment.

The following field assessment techniques have been selected as being the most suitable of those presently available for use in Washington State marine waters. Selection was based on the available baseline data, equipment, and personnel expertise available in the state, and present or anticipated availability of funds. These techniques are to be considered as guidelines subject to modification as our knowledge increases and our sampling equipment and sampling methodologies are refined.

Initial field assessment activities will emphasize those resources for which data may be lost due to migration, tidal action, and scavengers (fish, mobile invertebrates, birds, and mammals). Immobile invertebrates, habitats, physical structures, and planktonic organisms will have a lower assessment response priority. However, a lower assessment response priority for a given resource does not indicate a lower resource value; it only indicates the lesser vulnerability of that resource to data loss during the initial hours of the pollution incident or the complexity of the necessary sampling procedures.

Financial and personnel constraints of the state agencies also require selective prioritization of resources to be assessed in a marine resource damage assessment. For this response plan, resources were prioritized according to commercial and recreational values, availability of historical baseline data, ability to establish resource replacement costs, and the expertise of available agency personnel. Certain non-commercial organisms (marine birds and mammals) will be included because of their protected status. For those organisms included in the damage assessment, monetary values will be based upon Stokes (1979), actual costs incurred in restoration, extrapolation of known costs of restocking similar species, or revenue and catch data available from the state resource agencies. Biological and physical resources which will be included in a marine resource damage assessment are listed in section 8.0 of the text of this response plan. Those organisms and physical resources which will not be part of the damage assessment were eliminated on the basis of insufficient information on populations, no establishable monetary value, low assessment benefit/cost ratio, or non-availability of scientifically acceptable sampling methodologies. Resources not listed or added to the list at a later date will

receive only cursory study and be added into the assessment as biomass also affected unless they are included within the federal environmental damage assessment. Appropriate data derived from federal damage assessment activities will be included in the state's monetary damage assessment.

On occasion, field conditions may dictate necessary sampling modifications. Individuals utilizing these techniques should be familiar with the following publications: (1) *Field Detection and Damage Assessment Manual for Oil and Hazardous Material Spills* (EPA 1972); (2) *Procedures for Quantitative Ecological Assessments in Intertidal Environments* (Gonor and Kemp, 1978); and (3) *Oil Spill Studies: Strategies and Techniques* (American Petroleum Institute, 1977).

1. LABELING, DOCUMENTATION, AND CUSTODY OF SAMPLES

During the course of an environmental damage assessment, field personnel will acquire numerous field samples of diverse origin and purpose. These samples and their analytical results will form an important part of the documentation of damages inflicted upon the state's resources. Subsequent recovery of monetary damages based on the state's environmental damage assessment may involve the state in civil court actions. It will then be necessary for the state to prove that the samples were collected in a scientifically approved manner and that the samples were protected from outside contamination (non-incident related) and accidental mix-ups during handling and analyses. It is, therefore, extremely important that every sample be readily identified and their location and analytical status known and documented at all times.

A. Labeling

1. Label immediately upon obtaining each sample.

2. Use waterproof, adhesive labels; use large size labels; label outside of container only (lid optional).

3. Labeling should be done with water-resistent ink. No. 1 graphite pencil is an acceptable substitute. Lines should be drawn through errors - NEVER ERASE.

4. Labeling must include:

   a. Sample number;

   b. Location of sample origin;

   c. Identity of sample;

   d. Date sample obtained;

e. Time of sampling;

f. Type of preservative if added;

g. Printed name of sampler and agency;

h. Incident investigation identification; and

i. Storage instructions - may be placed on outer container if several or more similar samples will be normally stored in a common container.

Example

No. 3, Station 3-A	9/4/81
Floating Oil	time: 0930
50 ug HgCl added, refrigerate	
oil barge Mary Ann Spill	John Smith DOE

5. Title, sign, and date Polaroid photographs immediately (indelible ink preferred). Include names and addresses of witnesses, if available. If roll film is used, keep a record of the frame number and contents, date, etc.

B. Documentation

1. Document samples and associated field observations in hardbound, sequentially paginated notebook.

2. All notes should be written in the notebook at earliest possible time. Notes should never be written on scrap paper and then transferred to the notebook.

3. Do not remove pages from the notebook.

4. Notes must be written with indelible ink. Mistakes may be crossed out in a manner that leaves them readable. NEVER erase an entry or any part thereof.

5. Notes should include time of arrival of team, names of team members, weather and tidal conditions, ambient air and water temperatures, location of sampling area, prominent landmarks, substrate type(s), names of witnesses, type of pollutant, size of area affected, observations on affected biota, and other relevant material.

6. All field records should be initialed by the person making the entry at the time of entry. Entries should be countersigned by witnesses, if possible.

7. Close out each day's entries with a horizontal line, date, and initial.

8. Keep all original notes, even after typed copies have been prepared.

9. Laboratory notes should follow above format with appropriate modifications.

C. Custody

1. Predesignated storage facilities should be used for storing samples.

2. Access to the samples should be as limited as possible. If possible, storage facilities should be locked. In all cases, samples must be separated from samples pertaining to other projects.

3. One individual should be declared as custodian of the samples. When samples of different types or samples collected by different agencies are kept in separate locations, a custodian must be named for each sample set; however, the same individual may be named as the custodian in each case.

4. A custodian is responsible for keeping a record of all samples under his/her jurisdiction, the name of all persons having access to the samples, the movement and analyses performed (including dates and names) on the samples, and the location, storage, and custodianship of samples while they were away from the primary custodian's care.

5. If samples are sent through the mail, the samples must be properly packed and the shipping containers secured for shipment. Use only registered mail with return receipt requested. A sample transmittal sheet describing each sample and analysis to be performed must be included to identify contents. A copy of the transmittal sheet must be kept by the primary custodian.

2. FORENSIC DOCUMENTATION

The chemical nature of oil and other toxic substances often requires special precautions to ensure non-contamination of samples. At the time of the pollution incident, sample preservation instructions - i.e., type of containers, container cleaning methods, etc. - will be provided by the DOE, Biological and Chemical Investigations Section, or by the TeCom Chairman. Individuals responsible for water, sediment, and tissue sampling will be predesignated by TeCom or by authorized agency staff personnel.

Analytical methodologies employed in analyzing all samples will be those accepted by the scientific community at the time of the incident.

A. Water Quality Protocol

1. Triplicate samples should be collected at the surface (air-water interface), 1.5 meters, 3 meters, and, if appropriate, 10 meters and 30 meters.

2. Thoroughly cleaned and rinsed 0.5 or 1 liter containers should be used. If hydrocarbon contamination is suspected, the containers must be glass (lids must be Teflon or aluminum foil coated, or glass) (see D. Cleaning Procedures).

3. Surface samples may be dipped; other samples should be collected by gear which prevents contamination from the surface waters; i.e., a continuous flow submersible pump or SCUBA divers.

4. Sample containers should be sealed immediately after sample is collected. If preservative is required to prevent biodegration, it may be added prior to sealing or prior to collection.

5. After sealing, the lid or cap should be secured with adhesive tape or similar method and the sample labeled and placed on ice (if appropriate) until proper storage or analytical facilities are available (see E. Storage Procedures).

B. Sediment Sampling Protocol

1. The collection device (corer, grab, etc.) should be thoroughly cleaned and rinsed, and composed of a material incapable of contaminating the sample (see D. Cleaning Procedures).

2. Samples should be collected in duplicate, and each sample divided in half, each half being placed in a separate, thoroughly cleaned and rinsed glass container. Size of container depends upon size of sample required for analytical analysis.

3. Add preservative (if appropriate) and seal immediately with non-contaminating lid or cap.

4. Secure lid or cap with adhesive tape, label, and place on ice or freeze (-20°C) until analyzed (see E. Storage Procedures).

C. Tissue Sampling Protocol

1. Tissue samples should be confined to macroorganisms such as large filter-feeding or bottom-scavenging invertebrates (clams, oysters, shrimp, etc.) and benthic, bottom-feeding fishes.

2. Tissue samples need to be protected from external contamination at time of collection. Contents of the intestinal tract, external slime coating, contaminated collecting utensils, etc. are all potential sources of contamination (see D. Cleaning Procedures).

3. All collecting gear and sample containers must be made of materials free of extraneous contaminating substances.

4. Tissue samples should be collected as soon as possible after death of the organism. Decomposed organisms are rarely of any value for analyzing.

5. When possible, at least 10 grams of tissue from each organism should be collected. Tissue should include flesh and internal organs, especially liver.

6. Tissue samples should be placed in clean glass jars with non-contaminating lids, sealed, labeled, and frozen. Samples may be kept on ice until freezing is possible (see E. Storage Procedures).

7. Depending upon pollutant involved, whole carcasses may be wrapped in clean tinfoil and frozen, if whole animal analysis or laboratory dissection is appropriate.

D. Cleaning Procedures

No single container and instrument cleaning protocol is acceptable for use with all pollutant sampling regimes. Type of pollutant and analytical testing procedures to be performed determine the cleaning protocol as well as the composition of acceptable containers and sampling instruments (EPA, 1979a and 1979b). Individuals responsible for collecting samples for laboratory analyses will be either supplied with apporpirately cleaned containers or receive specific cleaning instructions from DOE. The following cleaning procedures apply to samples destined for hydrocarbon analyses (EPA 1979a, Clark and Brown, 1977).

1. Only containers and lids made of glass, solvent-extracted teflon, stainless steel, or aluminum foil are acceptable.

    a. Containers and lids are washed in hot water using a detergent acceptable for laboratory use. Unused aluminum foil does not need washing (see third rinse).

        (1) First rinse: tap water, then re-rinse in distilled water.

        (2) Second rinse: nanograde acetone.

        (3) Third rinse: methylene chloride, pentane, or hexane.

b. Wrap tightly in methylene chloride rinsed aluminum foil until used. Avoid hand contact.

2. Stainless steel sediment gear (shovels, grabs, cores, etc.) is used almost exclusively (glass, teflon, and aluminum gear is acceptable but uncommon except for small instruments used in transferring and examining samples).

   a. Before collecting each sample, the gear is rinsed with water then re-rinsed with methylene chloride, pentane, or hexane. It is advisable to wash gear with hot water and detergent at the end of each day (see 1., above) or more often.

   b. All instruments used in handling sample must be made of a non-contaminating material (see above) and rinsed with water and methylene chloride, pentane, or hexane between each sample collection. Avoid hand contact with sample.

3. Tissue samples must be collected and stored using appropriately cleaned non-contaminating instruments and containers (see 1., above).

   a. Whole organisms of suitable size may be stored in appropriate containers or wrapped in methylene chloride rinsed aluminum foil and returned to the laboratory for processing.

   b. Tissue sections from larger animals must be protected from accidental contamination.

      (1) Clean tissue surface to be cut with methylene chloride applied by cotton swab. Cutting instruments must not come into contact with uncleaned tissue.

      (2) When collecting internal organ tissue, remove or fold back enough surrounding flesh to facilitate access to internal organs.

      (3) Collect stomach and intestinal tract last.

      (4) Avoid hand contact with freed tissue.

      (5) NOTE: External slimes, exposed tissues, and intestinal tract fluids are all sources of contamination.

E. Storage Procedures

1. Each sample will be placed in a separate container.

2. Several sample containers may be stored together in a common container IF all samples have the same storage requirements.

3. Unless special preservatives or analytical storage procedures are used, samples will be stored at -20°C or lower until analyzed.

4. Samples must be frozen as soon as possible after collection. If freezing facilities are not readily available, samples may be kept on ice (preferably dry ice) until freezer space is available. Ice and higher freezing temperatures retard but do not prevent microbial and chemical changes within the sample.

5. Samples collected only for the purpose of organism identification and enumeration may be preserved in 10% formalin and stored at room temperature.

   a. Inject a volume of full-strength formalin (formaldehyde solution 37%) equivalent to 10% of the volume of water contained in a sediment sample and mix thoroughly.

   b. Organisms should be placed in a volume of 10% sea water buffered formalin equal to 10 times the volume of the organism(s).

      (1) Internal cavities of larger organisms should be opened.

6. Samples preserved under special conditions (i.e., histological samples fixed with formalin based fixes) will be stored according to the requirements of the preservative or analytical procedure to be performed.

F. Photography Protocol

1. Single-lens reflex (SLR) cameras are best all-around cameras to use.

   a. Color film or infrared color film should be used.

      (1) 35 mm slide films with an ASA above 100 are best choice for general use.

      (2) Self developing films (require special camera) are suitable if slide projection will not be required.

   b. camera and type of film used must be selected according to use.

2. Photo documentation should include:

   a. Affected area;

   b. Non-affected areas adjacent affected area;

c. Control areas;

d. Affected and non-affected biota in affected area, adjacent non-affected areas, and control areas (include a reference scale);

e. Sampling site prior to collection of sample;

f. Members of sampling team working on scene;

g. Major landmarks; and

h. Other relevant material suitable for photographic documentation.

3. METHOD FOR ASSESSMENT OF AFFECTED BIRD POPULATIONS

TeCom will provide data on shorelines affected or threatened based on the shoreward movement of the pollutant, habitat vulnerability, and resources endangered. The following is based on data provided by Wahl and Speich, 1980.

A. Aerial Survey

Aerial surveys will be used to census marine bird populations within and adjacent affected areas and control areas. Resulting data will be used for determining any population changes resulting from the pollution incident and subsequent population recoveries.

1. Establish sufficient aerial transects to cover waters and shorelines that are affected, endangered, or control areas. Whenever baseline study regions are involved, aerial transects will conform to those used in the baseline study.

2. Flights covering all designated transects should occur each day, if possible, for duration of incident and thereafter until environmental impact has stabilized.

3. Transects may be added during the survey if necessary, but deletion of transects should be avoided.

4. An altitude of 60 meters and a speed of 80 knots should be maintained at all times. In coastal areas, the transect should be located 60 meters offshore. Observation techniques will be the same as those used during the 2-year MESA baseline study (Manuwel, et al., 1979).

5. Each flight must include two experienced observers (three observers preferred) in addition to the pilot. Observers should be limited to the same personnel at all times, and all sightings recorded by the same individual.

6. Extensive photographic documentation should accompany sighting records.

7. Records of marine mammal sightings should also be kept.

B. Beach Walks

Data derived from beach walks will be used to document body counts, species affected, and forensic data.

1. Beach walks should occur on all accessible beaches. If extent of affected area exceeds the capability of available personnel, beaches of concern will be designated by TeCom.

2. During walk, the area of beach covered will include low tide mark to extreme high tide level, adjacent nearshore waters, and any land above extreme high tide level within a reasonable distance to include possible wanderings by affected birds.

3. Each beach should be walked at least every third day for the duration of the incident. Daily beach walks are preferred.

4. A walk team may be limited to a single individual or preferably, two or three individuals if available personnel permits.

5. Preferably, beach team members will be experienced in field identification of birds and have previous beach walk experience. Personnel thoroughly briefed on beach walk techniques are acceptable.

6. Detailed notes describing numbers and species affected and other relevant information must be recorded by the beach walk teams and photographic documentation included.

C. Small Boat/Ferry Observations

Data derived from small boat/ferry observations will be used to document body counts, species affected, and forensic data.

1. Small boat transects should be used in conjunction with beach walks when possible and in areas inaccessible to beach walk teams. Observations should occur as frequently as possible, every day being preferred.

2. Observation area should include 150 meters on either side of boat and should be limited to within 1000 meters of shore.

3. When affected waters include ferry routes, observations from ferries should be included. Observational area should be limited to within 500 meters on both sides of ferry.

4. Observers utilized on small boat/ferries should be experienced in field identification of birds.

5. Detailed notes describing numbers and species affected, water conditions, and other relevant information and photographic documentation must be kept.

D. Carcass Counts

1. All beached and floating carcasses should be collected, bagged separately, tagged or labeled, and frozen as quickly as possible for later laboratory examination. If kill is extensive, collecting of a random sample will be acceptable. Carcasses should be placed on ice or refrigerated until freezing is possible.

2. All carcasses not collected for laboratory examination should be counted and species, sex, and age (if feasible) determined or estimates thereof made. These carcasses must be removed from the beach or identified in a manner that will prevent repetitious counting.

3. Moribound birds and those birds exhibiting abnormal behavior which are found within or adjacent to affected areas should also be collected.

4. A sufficient number of carcasses should be sent to an authority on bird identification for species confirmation.

5. An appropriate sample of the carcasses should be sent to TeCom approved labs for autopsy to establish cause of death and for chemical analyses to confirm pollutant contamination.

6. In the event of oiled or otherwise coated birds, a few uncleaned skin mounts should be made for use as evidence in court procedings.

7. All other collected carcasses should be examined by trained personnel for confirmation of species identity, sex, age, and cause of death, if determinable, before discarding.

E. Rehabilitation Counts

1. Designated observers will be stationed at rehabilitation sites established by volunteer groups for the purpose of recording number of birds brought to the site, species involved, collecting and tagging mortalities, and survival rates of treated birds.

F. Habitat Assessment

1. Nesting sites, roosting rocks, and other land habitats which occur within or adjacent to the affected waters or are utilized by birds subject to impact will be observed by teams of experienced personnel (one to five individuals/team).

2. Extent of habitat affected either directly by the pollutant or indirectly through contamination by contaminated birds (e.g., eggs and nests oiled as a result of contact with oiled feathers of an adult) will be assessed.

3. Photographic documentation depicting contamination will be of primary importance.

G. Post-Impact Monitoring

1. Aerial transects will be established on the basis of baseline data to monitor the affected bird populations (standing crop) on a monthly basis for one year and on a quarterly basis for one or more additional years pending availability of funds.

2. Beach walks will be done on a weekly basis for one month post cleanup.

3. Habitats will be monitored on a weekly basis (post cleanup) for three months and on a quarterly basis for one or more additional years pending availability of funds.

4. Field study of eggs for hatchability (Stickel and Dieter, 1979) will be performed for any species affected during a nesting season.

5. Tagging studies (survival rate) will be performed if rehabilitated birds are tagged, pending availability of funds.

H. Damage Assessment

1. Body counts.

2. Reduction of standing crop where correlation between standing crops, body counts, and baseline data exist.

3. Reduction in hatching success.

4. METHOD FOR ASSESSMENT OF MARINE MAMMAL POPULATIONS

Tecom will provide data on shorelines affected or threatened based on the shoreward movement of the pollutant, habitat vulnerability, and resources endangered.

A. Aerial Survey

Aerial surveys will be used to census marine mammal populations that may be affected by the pollution incident.

1. Establish sufficient aerial transects to cover waters and shorelines that are affected or endangered.

2. Each flight should follow routes designated prior to the beginning of the survey.

3. Altitudes of 100 to 150 meters should be maintained during survey of coastal areas; 200 meters or less for open water flights.

4. Flights should be repeated once each day if possible for duration of incident.

5. Transects may be added during the survey, if necessary, but deletion of flights should be avoided. Each flight must include two experienced observers (three observers preferred) in addition to the pilot. Observers should be limited to the same personnel at all times.

6. One observer, predesignated as recorder, should always record sightings.

7. Photographs of all sightings should be made, along with photographs of affected area. Photographic equipment must be selected according to working conditions.

8. Location of all dead or abnormally behaving animals must be recorded and, if possible, animals observed from a boat. Tissue samples or entire carcasses should be collected whenever possible.

9. Records of marine mammals sighted during aerial bird surveys should be integrated into collected data.

B. Boat/Land Observations

Boat/land observations will be used to refine aerial survey observations and for observing behavior of animals.

1. Land and boat observations should be utilized on coastal areas, around and on pinniped haulout sites and breeding colonies, and near feeding grounds, when known.

2. Whenever possible, personnel involved in boat and land surveys should be acquainted with the area.

3. Land and boat observations should occur before, during, and after impact to the greatest possible extent without causing undue stress to animals under observation.

C. Sightings from Other Sources

1. Sighting reports concerning the affected area from the various organized mammal watching societies, fishermen, ferry operators, and the general public will be utilized as general backgroung data; however, reliable observers may be utilized as witnesses.

D. Forensic Documentation

Marine mammals are protected by both state and federal regulations. In order to establish a water quality violator's liability for the injury or death of a marine mammal, probable cause of injury or death must be established for each affected animal.

1. All floating or beached carcasses (or tissue samples thereof) will be collected and sent to TeCom approved laboratories for autopsy and tissue analyses.

2. Autopsies must be performed by qualified personnel such as marine mammal veterinarians or qualified marine mammal field biologists.

E. Body Counts and Population Estimates

1. Body counts will include floating and beached carcasses, strandings, and adult and juvenile mortalities on hauling out areas and breeding colonies whenever the pollutant can be identified as a probable cause of death or stranding or as a contributing factor to death or stranding.

2. Decreases in population numbers of affected populations as a result of documented pollution impact to adults, juveniles, or their habitats will be assessed utilizing baseline data acquired from the DOE baseline project, WDG baseline studies, and National Marine Mammal Laboratory/Marine Ecosystems Analysis baseline studies (Everitt, 1979).

F. Damage Assessment Claims

Damage Assessment Claims will be based on:

1. Known restocking costs.

2. Estimated restocking costs based on maintenance records of zoos and aquariums.

5. METHOD FOR ASSESSMENT OF INTERTIDAL ORGANISMS

Assessments will be limited to economically valuable bivalve molluscs and crabs and, when present, surf smelt and Pacific herring spawners and

their spawn. Incidental data collected on other intertidal organisms will be retained for possible long-term recovery studies.

TeCom will provide data on shorelines affected or threatened, based on the shoreward movement of the pollutant, habitat vulnerability, and resources endangered, and land ownership.

A. Establishing Sampling Sites

1. Photograph affected beach areas and adjacent non-affected areas. Include photographs of affected and non-affected organisms. Aerial photographs should be obtained if possible.

2. Record general observations on the severity of contamination in affected areas and at several random locations, measure depth of penetration of the pollutant into the substrate. Record names and addresses of witnesses to substantiate recorded observations. Written statements from witnesses are desirable.

3. For substrate classification, collect several random core samples (volume of 2 liters) between 0 ft and +8 ft tidal heights and store in labeled plastic bags. Cores should be taken to a depth of 30 cm or until bedrock or hardpan is reached.

4. Measure total area of affected shoreline.

5. Record water temperature (take sufficient number of readings to characterize the water temperature(s) in the immediate vicinity of the affected beach), collect water samples and record prevailing weather conditions.

6. Record temperature of affected and non-affectes substrate at 0, 1, and 5 cm depths and similar temperatures of substrate in control area (take sufficient number of readings to characterize the substrate). Temperatures should be taken during warmest time of day.

7. Using reference markers, establish permanent reference lines up to 100 m in length parallel to the water on high ground. At least two reference lines per 500 m of linear beach should be established. Reference lines should include all substrate types present on beach. On large, homogeneous beaches, the number of permanent reference lines may be reduced.

8. Identify permanent reference lines on a map of the area. Map should show shoreline, roads, and other significant features.

9. When available, control sampling areas should be established and sampled in the same manner as affected areas.

B. Sampling Procedure: Hard Shell Clams

1. Initial sampling will occur within 3 days of impact and thereafter on a weekly basis for 1 month after impact or until the mortality rate has stabilized. Subsequent sampling will occur on a quarterly basis for 3 years or until clam populations have stabilized, pending availability of funds.

2. After establishing permanent reference lines, select at random several sampling transects perpendicular to the permanent reference lines. Sampling transects should extend from 0 ft tidal height or low-water line (whichever is lowest) to +8 ft tidal height or the highest boundary of the clam beds.

3. Establish sampling stations along the sampling transect at locations approximating common tidal heights.

4. A ring or square enclosing 0.25 square meter will be used to define replicate sampling sites at each station.

5. Record all organisms and vegetation occurring on the surface within the ring or square. Also include state of health (normal, stressed, dead) and degree of contamination of substrate and depth of penetration of pollutant. Sediment samples for chemical analysis may be collected at this time.

6. Remove replicate 0.25 square meter samples to the depth of 30 cm or until bedrock or hardpan is reached.

7. Sieve samples through a 0.5 inch screen. SAVE ENTIRE SAMPLE.

   a. If time does not permit field screening, the sample may be processed in the laboratory at a later date. The following steps would then be performed in the field or laboratory.

      (1) Collect all clams that do not pass through the screen. Separate living and stressed (narcotized) clams and place in separate containers. Tissue samples may be collected at this time.

      (2) Place entire sample including separate containers for clams into a common container; label and store container with ice or freeze for later analysis.

8. Sampling of beds extending into the subtidal is discussed later.

C. Sampling Procedure: Razor Clam

1. Initial sampling will begin within 12 hours of impact and continue daily until acute mortality has ceased. Sampling for latent mortalities will continue on a weekly basis until

mortality rate has stabilized. Nighttime sampling periods will be included. Sampling will occur during lowest available tides.

2. Permanent reference lines parallel to the water will be established on high ground.

3. Sampling transects will be established at random intervals perpendicular to the permanent reference lines. Each sampling transect will be 30 to 100 meters in length and include random tide heights between high tide line and water line and within accessible surf zone (lagoon area).

4. A 3-meter swath transect will be walked and clams counted. Replicate transects will be sampled.

5. Counted clams will be classified as: (a) Normal show; (b) "Neckers" (distressed) - clam in normal position in sand with neck extended and flaccid; (c) Dead, on surface; (c-1) fresh shell with tissue; or (c-2) fresh shell without tissue.

6. At random intervals, clams will be collected for tissue analysis and normal showing clams will be collected for use in tainting studies. Whole clams will be collected and frozen.

7. In the surface zone, include an additional class, (d) "drifters", moribund and dead clams which have detached from the substrate.

8. "Drifters" will be sampled using a beach seine of known length within the surf zone (lagoon area). In deeper subtidal waters, a beam trawl or otter trawl will be used, weather and surf conditions permitting.

9. After initial mortalities have subsided, a gradient sampling scheme will be used to determine extent of damage to razor clam populations. Sampling will be done using a marked clam-recovery method which the WDF uses annually to determine the population of harvestable clams available (Tegelburg and Magoon, 1968).

    a. Sampling areas of 3 meters by 30 meters will be set up immediately adjacent to the sampling areas of the previous fall population studies.

    b. Clams dug from outside the area will be marked with a letter and number using an electric hand drill then replanted within the designated area. Marked clams will be measured for length and enumerated for each 100 ft section west of a survey baseline.

    c. On the following tide series, each area will be re-dug and all clams recovered will be measured and recorded. Each section will be dug a total of at least two times until a minimum of 20% of the marked clams are recovered.

d. The population is determined by the ratio of the marked to non-marked recoveries. A comparison can then be made with the adjacent area sampled earlier.

e. The original area will also be re-dug to obtain marked and non-marked clams for growth and additional population information.

10. There will be a number of factors to consider in the analysis, such as the amount of time the area has been open to sport harvesting, what size of clams will be excluded from count to eliminate any recruitment factor from the original fall sampling site, and location of sampling site in reference to impact area of spill.

11. Additional gradient sampling will also be set up in or near impact area if no previous WDF sampling areas exist.

12. Monthly sampling will be conducted for indication of mortalities of set clams (3 mm to 52 mm). Areas sampled will be the same areas sampled during fall population studies.

    a. Approximately 10 samples (0.36 sq m x 22 cm deep) randomly collected within each gradient sampling area will be put through a 1.5 mm mesh screening cart. The sand is then flushed out and the remaining clams counted and measured. This data will be compared to previous monthly sampling to check for any major differences in population levels.

14. Sediment samples for chemical analyses should be collected periodically from affected and non-affected area from time of impact until termination of sampling.

D. Sampling Procedure: Oysters and Mussels

1. Sampling will begin within 5 days of impact and continue on a weekly basis until the latent mortality rate has stabilized. Subsequently, sampling will occur on a quarterly basis for 3 years, pending availability of funds.

2. After establishing permanent reference lines on high ground, sampling transects will be randomly established perpendicular to the permanent reference lines. Sampling transects will extend from low water line to upper boundary of the bed.

3. All oysters or mussels occurring within a 1-ft swath along the sampling transect will be counted, measured, and age estimated according to size (0 yr, 1 yr, 2 yr, 3 yr or older) (WDF, unpublished data), and classified as (a) Normal appearing; (b) Moribund or narcotized; (c) Dead with tissue present; (d) Dead without tissue but shells still hinged; (e) Whole (unbroken) unhinged shells.

4. When shellfish beds are extremely large, randomly spaced, 10-ft sections of the sampling transects may be used for counting as an alternative to counting along the entire length of the sampling transect.

5. Replicate transects should be sampled.

6. Tissue from normal appearing and moribund individuals should be collected and frozen for future chemical analysis.

7. Sediment samples should be collected periodically from time of impact until termination of sampling.

8. Sampling of beds extending into the subtidal is discussed later.

E. Sampling Procedure: Crabs

1. Sampling should begin within 12 hours of impact and continue daily until acute mortality ceases. Subsequent sampling should be continued on a monthly basis until latent mortality has stabilized. Population monitoring should continue on a quarterly schedule for 1 year.

2. Random sampling transects perpendicular to permanent reference lines established on high ground should extend from low water line to extreme high tide line.

3. Survey a 4-meter wide swath along each of the sampling transects.

4. Collect all living and dead red rock crab (Cancer productus) and Dungeness crab (Cancer magister). Note should be made of other crab species observed.

5. Record specimens as: (a) Living; (b) Moribund or narcotized; or (c) Dead.

6. Count, sex, and measure carapace each species separately. May be performed in the lab if time is limited.

7. All specimens or subsamples thereof should be frozen (keep on ice until freezing is possible) for lab analyses.

8. If crab carcasses have collected in windrows in the upper tidal heights, representative sections of the windrow should be selected and all carcasses with the section should be counted and sorted by species and sex and carapace measurement recorded.

9. In affected and adjacent areas supporting commercial harvesting of Dungeness crab (outer Pacific coast), the commercial catch should be observed for health abnormalities and random

samples of tissues collected and frozen for future chemical analyses and tainting studies (Appendix IX).

10. Crab samples will be obtained from affected areas and adjacent areas by means of crab pots, ring nets, and beam or otter trawl. Health condition will be recorded and tissue samples collected.

F. Laboratory Procedures

1. All samples will be logged in and chain of custody and proper storage arranged or chemical analyses performed.

2. Core samples will be sieved through Tyler sieves to determine particle size of the beach substrate. Substrate will then be classified according to DOE baseline designations (see Appendix X).

3. All 0.25 sq.m. hard shell clam samples will be sorted. Bivalves will be identified by species, measured and classified as: (a) Living; (b) Stressed; (c) Dead with tissue present; (d) Dead, hinged shells; and (e) Whole, unhinged shells. All other organisms will be sorted by species or family group and counted (Appendix XI A). Representative samples of non-bivalves will be preserved in 10% seawater-buffered formalin and stored for future reference.

4. Statistical population/mortality analyses will be performed on organisms designated as economically valuable in Section 8 of the text of this plan.

6. METHOD FOR ASSESSMENT OF HERRING POPULATIONS

WDF possesses stock assessment data on most populations in Washington waters. Therefore, damage assessments will be made on the basis of mortality of spawning adults and spawn at known spawning grounds and reduction in related stock assessment.

TeCom will provide data on shorelines affected or threatened based on shoreward movement of the pollutant, habitat vulnerability, and resources endangered.

A. Herring Spawning Ground Surveys

1. Assessment of herring spawning will occur only on the known spawning grounds and only during the months when herring are spawning or spawn is present. Maps available from WDF.

2. Sampling of spawning grounds should be undertaken during periods of high tide.

3. Whenever possible, pre- and post-impact surveys should be performed.

4. When feasible, SCUBA transects similar to those used for nearshore fishes and low-water field surveys (beach walks) should be performed in conjunction with normal spawning ground surveys.

5. A shallow-draft vessel equipped with an outboard motor and capable of operation in tight maneuvering situations and operationally safe in rough, in-shore water conditions should be used.

6. A field crew will consist of two (2) persons, one (1) of which will be the designated recorder. Both should be experienced in herring spawning ground surveys and preferably familiar with the grounds being surveyed.

7. Vegetation will be sampled at sites located every 350 to 400 meters along the shoreline for the entire distance of the spawning grounds.

8. Vegetation will be collected with the use of a "rake" of similar construction as the "rakes" presently utilized by WDF.

9. Multiple stations (location of actual tows) may be required at each sampling site where suitable spawning habitat occupies a wide breadth of the littoral zone.

10. At each station, beginning and ending points are recorded on a nautical chart, collected vegetation is identified down to genus, density of spawn is estimated, and a small representative sample of spawn-laden vegetation is preserved in stockards solution (4 parts acetic acid, 5 parts formaldehyde [38%], 6 parts glycerine, and 85 parts distilled water) for age and mortality analysis.

11. All adult mortalities (or a representative sample if mortalities are numerous) will be collected and kept on ice or frozen until they can be analyzed in the lab for reproductive condition and pollutant contamination. Samples of spawn will also be kept on ice until it can be frozen and sent to a lab for pollutant contamination analysis.

12. Sampling should occur every 3 days until all spawn has hatched.

B. Juvenile and Adult Stock Assessment

1. Impact on juveniles will be based on tow-net surveys similar to those described by Miller, et al., 1978 (nearshore phase - June, July, and August).

2. Abundance of herring aggregating in deep waters (October to May) will be accomplished through use of hydroacoustic-midwater trawl surveys (Lemberg, 1978).

C. Laboratory Techniques

1. With a binocular microscope (10 x to 15 x), percent mortality and age composition of embryos is estimated. Embryonic age will be determined using WDF's developmental stage sequence data.

D. Habitat Assessment

In the event of pollution impact to a spawning ground prior to a spawning period which prevents spawners from using the area or reduces the success of spawning, lost production would be based on a five-year average of spawning success or best data available.

7. METHOD FOR ASSESSMENT OF SURF SMELT POPULATIONS

Surf smelt (Hypomesus pretiosus) are one of the more widespread nearshore fishes. Unlike other nearshore fish species, surf smelt utilize a specific spawning substrate in the high intertidal zone. This characteristic makes them highly vulnerable to pollution impact during their spawning periods.

Surf smelt will be included in the damage assessment only if spawning adults, deposited spawn, or early larval stages are affected during a pollution incident.

7. Tidal and weather conditions at time of sampling (and for duration of spill, if possible) will be recorded along with description of beach, estimate of impact, names and addresses of witnesses, and other pertinent data.

8. The percentage of suitable spawning substrate in a 2 m swath along each transect will be determined.

9. Sampling sites will be selected along each transect for each one-foot tidal height or as patchiness of suitable substrate dictates.

10. At each sampling site, all adult carcasses will be collected, sexed, and placed on ice or frozen for future fecundity studies and chemical analyses.

11. At each sampling site, cores, 2 liters in volume, of the substrate will be taken to the depth of 3.0 cm.

12. The substrate will be preserved with Stockard's solution (4% glacial acetic acid, 6% glycerien, and 5% Formalin [38%] in distilled water).

13. At random sampling sites within the affected area, small samples of spawn will be collected. The samples will be pooled and kept on ice or frozen until analyzed.

B. Laboratory Studies

1. Eggs in each preserved sample will be counted. Subsamples will be examined under a dissecting scope for age evaluation, fertilization, and mortality rates.

2. Fecundity studies will be performed on adult carcasses.

3. Adult carcasses and pooled samples of spawn (frozen) will be analyzed for tissue contamination.

8. METHOD FOR ASSESSMENT OF SUBTIDAL ORGANISMS

Assessment of subtidal organisms will be limited to fish and macro-invertebrates which have an establishable economic value (Stokes, 1979). Data on other species gathered incidentally during the assessment will be retained for possible use in long-term recovery studies.

TeCom will provide data on shorelines affected or threatened based on the shoreward movement of the pollutant, habitat vulnerability and resources endangered.

A. General Sampling Aspects

1. Sampling schedule will be:

   a. Within 96 hours of pollutant impact;

   b. One week after impact; and

   c. Weekly thereafter until acute effect (die-off) of pollutant impact has stabilized.

3. Long-term damage and recovery studies will follow Washington State DOE baseline methodologies.

B. Preparatory Procedures

1. Classify habitat(s) and substrate(s) within the area to be sampled according to habitat classifications defined by DOE baseline (Appendix X).

2. Estimate total area affected by pollutant.

3. Record water temperature, weather conditions, tidal height, observations on extent of impact (estimate of affected subtidal substrate, presence or absence of mortality of mobile organisms, etc.), names and addresses of witnesses, public use of affected shoreline, and other relevant data.

4. When feasible, randomly select a point within the affected area to begin a SCUBA transect and mark with flag or other distinctive marker.

   a. If the affected area is large or contains a number of different types of habitats, more than one SCUBA transect point should be marked with each habitat type having at least one SCUBA transect.

5. Most subtidal waters of the outer Pacific Coast are unsuitable for SCUBA transects and therefore will be sampled with trawls and dredges or photo sled (waters deeper than 20 meters).

C. Compass Transect (SCUBA)

1. Compass transect procedure is same as described for nearshore fishes (Appendix VIII 9).

D. Sampling Clam and Geoduck beds

1. If a subtidal hardshell clam bed(s) or geoduck (Panope generosa) bed(s) is(are) found during SCUBA survey, the bed(s) will be sampled separately.

2. Hardshell clam beds will be sampled by divers using a venturi suction dredge.

   a. A metal ring enclosing an area of 0.1 square meter will be placed at random upon the substrate. The substrate enclosed is then removed using a venturi suction dredge (Goodwin, 1973a).

   b. Collected specimens are handled as described above.

3. Geoduck beds will be sampled by divers counting "shows" (either siphons or depressions of the substrate indicating the presence of a siphon).

   a. Divers establish transects 50 meters long (or until a depth of 20 meters is reached) perpendicular to the shore.

   b. Divers then survey a swath 1 meter on each side of transect and place markers at each "show" (Goodwin, 1973b).

c. Individual geoducks should be collected on a random basis (method described for intertidal hard shell clams) using a corer or similar device.

d. Collected specimens are iced or frozen for future laboratory analyses.

9. METHOD FOR ASSESSMENT OF NEARSHORE FISHES

Nearshore fish populations subject to monetary assessment will be limited to species identified by Stokes (1979) as having an establishable economic value. Data on other species gathered incidently during the assessment will be retained for possible use in long-term recovery studies.

TeCom will provide data on shorelines affected or threatened based on the shoreward movement of the pollutant, habitat vulnerability, resources endangered, and land ownership.

A. General Sampling Aspects

1. All sampling will be done during slack water conditions.

2. Sampling schedule will be:

   a. Within 24 hours of pollutant impact;

   b. One week after impact; and

   c. Weekly thereafter until acute effect (die-off) of pollutant impact has stabilized.

3. Long-term damage and recovery studies will follow Washington State DOE baseline methodologies or similar methods approved by TeCom and WDF.

B. Preparatory Procedures

1. Classify habitat(s) and substrate(s) within the area to be sampled according to habitat classifications defined by DOE baseline (Appendix X).

2. Estimate total area affected by pollutant.

3. Collect water and sediment samples for analysis.

4. Record water temperature, weather conditions, tidal height, observations on extent of impact (estimate of subtidal substrate, presence or absence of mortality of mobile organisms,

etc.), names and addresses of witnesses, public use of impacted shoreline, and other relevant data.

5. Within affected area, randomly select a point to begin a SCUBA transect and mark with flag or other distinctive marker.

6. If the affected area is large or contains a number of different types of habitats, more than one SCUBA transect point should be marked with each habitat type having at least one SCUBA transect.

7. When water conditions or unavailability of personnel prevent SCUBA operations, beach seining may be substituted (Section E).

C. Compass Transect (SCUBA)

1. SCUBA divers should always work in pairs, with one diver designated as recorder. WISHA regulations will be followed at all times.

2. The course of the transect will be determined by compass bearings. The first leg of the transect is at a 45-degree angle from the bench, from the water line to a depth of 15 or 75 meters, then 90-degree angle back to the beach. Repeat until approximately 250 meters of beach footage have been covered. Point of direction change should be marked with a buoy.

3. A path 5 meters wide should be investigated along the transect route. Underwater visibility should be measured.

4. All carcasses and moribund specimens of species with established values will be collected.

5. Care must be taken to ensure that carcasses are not overlooked because of lodgement under rocks or in crevices.

6. Record of carcasses of non-economically valued species will be kept and random samples will be taken for future reference.

7. Record of live organisms will be kept. Condition of algae covering should also be noted.

8. Collect water and sediment samples for laboratory analysis (Appendix VIII 2.).

9. When transect is completed, collected specimens will be preserved in ice or frozen for future laboratory studies.

10. Samples of moribund specimens, if available, will be placed in a 10% saltwater-buffered formalin solution for histological studies.

11. The rest of the specimens (or a subsample thereof) will be placed in non-contaminating containers, sealed, labeled, and frozen for future laboratory analyses.

12. Actual distance covered during transect will be determined by measuring distance between the buoys. This measurement multiplied by the width of the transect (5 m) will give the total area of the transect.

13. Population and mortality estimates (organisms per m^2) derived from the transect area will be extrapolated to determine population and mortality estimates for the total affected area.

14. Information taken for each specimen collected will include species, sex, length, weight, reproductive condition, and any apparent disease or abnormality.

D. Exposed Substrate Transect

Fish carcasses will be found in the intertidal areas. They may be collected during intertidal investigations or separately as conditions indicate:

1. Establish permanent reference lines 250 meters in length on high ground parallel to the water. Randomly establish sampling transects at a rate of approximately 3 per 50 meters (approximately 15 transects total).

2. Between high water line and low water line, the beach will be sampled using the selective stratification (habitat zones) technique utilized in the DOE Baseline (Appendix X A.).

3. Each sampling site will be carefully examined for carcasses. For each carcass, species, weight, length, sex, reproductive condition, and visible lesions will be recorded.

4. Carcasses of all economically valued species or a sufficiently large random sample thereof will be collected and frozen as quickly as possible for future analysis.

5. Mortality estimates will be made for each stratified sampling region.

6. Intertidal invertebrates may be sampled at the same time.

E. Beach Seine

Weather conditions, turbid waters, currents, and other factors may prevent the use of SCUBA. Under these conditions, beach seines may be used.

1. Methodology for beach seining is described in Appendix X B.

10. METHODS FOR HABITAT ASSESSMENTS

For the purpose of habitat damage assessments, habitat will be defined as available substrate and associated flora. In most instances, habitat damage assessment activities should be performed concurrently with intertidal and subtidal damage assessment activities.

TeCom will provide data on shorelines affected or threatened.

A. Infra-red Aerial Photography

1. Pre- and post-impact aerial photography should be utilized to the greatest extent possible. Factors affecting usefulness of infra-red aerial photographs include:

   a. Weather;

   b. Time of day and tidal heights;

   c. Water surface conditions; and

   d. Availability of aircraft.

2. All infra-red aerial photographic work should be performed at time of lowest feasible tidal height.

3. Infra-red aerial photography should be considered for the following surface areas:

   a. Intertidal area from extreme high tide line to water line;

   b. Exposed mud flats;

   c. Marshes;

   d. Floating kelp beds; and

   e. Islets, rocks, and other exposed lands which may be used by pinnipeds or marine birds.

4. Photographic parameters include:

   a. Use of 9" x 9" black-and-white infra-red film and appropriate camera equipment;

   b. A photographic scale of 1:7200 (1" = 600'). Inclusion of objects of determinable size is desirable for use as scale references; and

c. Visibility consistant with standard aerial photography survey proceures.

5. Infra-red aerial photographs should be used in conjunction with field sampling procedures.

B. Substrate Sampling

1. Substrate samples should be collected as part of the intertidal and subtidal sampling activities.

2. Cores (15 cm in depth) totaling 1 liter in volume (or other volume, if appropriate) should be collected at random quadrats along transects established for intertidal and subtidal investigations.

3. Samples should be placed in glass containers, sealed, labeled, and stored on ice until freezing is possible. Preservatives, if required, may be added prior to sealing.

4. Samples should be frozen as soon as feasible and kept frozen until analyzed.

C. Benthic Algae (excluding floating kelps)

1. Benthic algae should be sampled during intertidal and subtidal sampling activities.

2. It is recommended that benthic algae be sampled according to method described in Appendix X (Intertidal Sampling and Processing Methods).

D. Floating Kelps (Nerocystis and Macrocystis)

1. Unless otherwise directed by TeCom, it is recommended that damage assessments of floating kelp beds be modeled after the Kelp Inventor Method (KIM-1) developed by Dr. Ronald E. Foreman (1975) of the Department of Botany, University of British Columbia (Coon, et al., 1976).

E. Higher Plants

1. Higher plants include the vascular plant species of the sea grasses, tidal marsh, and beach communities.

2. Affected areas containing significant higher plant vegetation will be identified during beach and boat surveys for wildlife and aerial overflights.

3. Field team surveys and aerial photographs should be used to map the boundaries of contaminated vegetation in each affected area.

4. In the field, field teams should mark the boundaries of contamination with flags or other methods.

5. The team leader should be experienced in identifying the higher plants associated with the marine environment of Washington State.

6. Vegetational transects would be deployed within the area of concern in a stratified random pattern. For large, more or less continuous masses of oil, two strata would be defined on the basis of whether or not the vegetation had come into contact with the oil. If the areas of contact were relatively small individually but involved a large area of vegetation, this would be sampled as a single stratum. The number of transects would depend upon the acreages and the uniformity of the vegetation.

7. The transect would be oriented perpendicular to the directional trend of the beach. It would start in the highest vegetation affected by the tides and would continue seaward to the outer edge of plant growth or to the limit set by water depth, whichever point was higher.

8. Each transect would be marked by a steel post or other durable object at or above the high-tide line. Distance and magnetic azimuth from a reference point would be accurately measured and recorded.

9. Each principal vegetational zone would be sampled by a subtransect perpendicular to the trunk transect and centered on it. The subtransect would be 40 meters in length. The intersection of transect and subtransect would be marked by 1 m of plastic garden hose inserted in the ground with about 15 cm above ground. The distance from the steel post and the distance and magnetic azimuth from the reference point to the mid-point of each subtransect would be recorded. Each transect would be plotted on the base map.

10. For salt marshes, a 1-m^2 quadrat frame would be centered at every 2 m from the trunk transect in both directions (20 quadrats). The quadrats would be mapped to indicate ground cover by plant species.

11. For the sea grasses, the quadrat would measure 30 cm on the side, and subtransects would be located along the trunk transect at elevation intervals of 1 foot.

    The number of turions within the frame would be counted, and the length of the longest leaf on three randomly selected turions would be measured.

12. Odd-meter points on the subtransects of both sampling methods would be reserved for the collection of such samples as would be required for laboratory analysis or for calibrating the density-length data for estimates of biomass.

13. Black and white, fixed-point photos would be taken of each transect from the highest vantage point. Color and black and white photos would be made of two quadrats, randomly chosen, on each subtransect. This series of photos would be repeated in each subsequent survey. All opportunities for the making of comparison photos including aerial infra-red photos would be exploited.

14. Some plant species would be difficult or impossible to detect from late fall to early spring. Therefore, the transects should be remeasured during the August following the spill. If a significant difference then existed between the oil-contact areas and uncontaminated areas for any of the parametric estimates, the need for additional measurements in August of the following year should be considered.

F. Damage Assessments

Habitat damage assessments should be limited to verification of substrate contamination and changes in flora biomass, species composition, and percentage of cover. Except for cases where monetary dollar values may be establishable for certain species of flora, habitat damage assessments will be primarily used as supporting evidence for loss of organisms.

11. METHOD FOR ASSESSMENT OF OPEN WATER ORGANISMS

Pollution-related damage assessments to open water organisms will occur only under special conditions and will include primarily planktonic organisms. A monetary damage assessment will be conducted, as determined by TeCom, when:

1. Pollutant-impacts affect such an extensive area of open water that loss of primary food producing organisms (algae) is great enough to actually threaten the food producing capabilities of the region;

2. The pollutant-affected waters contain a large proportion of larvae of an economically valued species; i.e., waters adjacent to herring and surf smelt spawning grounds;

3. The pollutant-affected area has a restricted water flow (estuaries, etc.), the impact is extensive, and recruitment of primary producers is expected to be slow; and

4. Other circumstances which TeCom deems hazardous enough to the food producing capabilities of the affected waters to warrant assessment.

A. Field Studies

1. Field sampling must begin as soon as possible after discharge of the pollutant.

2. Approval of the federal OSC should be obtained prior to initiation of the sampling because of the need for operating in the vicinity of the discharge which may interfere with cleanup operations if not coordinated.

3. Existing federal guidelines regarding legal aspects of field sampling as set forth in the EPA manual *Field Detection and Damage Assessments Manual for Oil and Hazardous Material Spills* (EPA, 1972), should be followed.

4. It is suggested that the combined field sampling/bioassay method recommended by Hirota, et al., (1977) be used unless the TeCom states otherwise.

5. In the field:

   a. Photograph discharge (source and affected waters), mark affected waters on nautical chart of area, note weather, tidal heights, currents, type of discharge, source of discharge, names of witnesses, etc. Include aerial photographs whenever possible;

   b. Establish control and reference stations. Control stations should be located in waters unlikely to be affected and be similar to the affected waters in temperature, salinity, depth, water quality, and general habitat characteristics (especially in an estuarine situation). Reference stations should be located in waters adjacent to pollutant-affected waters, but not affected. Reference stations will change as pollutant disperses;

   c. Collect samples of pollutant and water from affected waters (obtain a raw sample of the pollutant)(Appendix IX-1). Water samples for bioassays (Appendix IX-1) should be stored in air-tight glass jars or carboys with teflon lined caps and stored on ice for shipment to lab;

   d. Collect replicate water samples (1 to 4 liters) from within 1 to 3 meters of the surface at random points throughout the affected waters. Preserve samples in 2% seawater-buffered formalin solution for phytoplankton and micro-zooplankton analyses;

e. Collect zooplankton samples from affected waters using plankton net (0.18 - 0.33 mm mesh). Preserve samples in 5% seawater-buffered formalin solution. If pollutant is a petroleum product or other slick forming substance, tows should be made at edge of slick to prevent contamination of sample. Replicate tows should be made in several regions of the affected waters to ensure adequate sampling of the zooplankton populations;

f. Collect samples similar to those described in steps 3 through 5 from control and reference stations; and

g. Sampling periods should include both daytime and nighttime periods to ensure inclusion of vertically migrating zooplankton species.

B. Laboratory Studies

1. Organisms (plant and animal) in the preserved field samples should be enumerated and identified down to species, if possible.

2. Acute toxicity bioassays of the discharged pollutant should be performed following the appropriate American Society for Testing and Materials Method: *Standard Practice for Conducting Acute Toxicity Tests with Fishes, Macroinvertebrates, and Amphibians* or *Standard Practice for Conducting Static Acute Toxicity Tests with Larvae of Four Species of Bivalve Molluscs.*

3. Receiving water bioassays as described by Cardwell and Woelke (1979) and Hirota et al., (1977) should be performed utilizing larvae of at least one invertebrate and one vertebrate, and at least one phytoplankton. If possible, species inhabiting the affected area should be utilized. Selection of bioassay technique will depend upon requirements and objectives of the investigators.

12. METHOD FOR ASSESSMENT OF BENTHIC POPULATIONS

In the event that a pollutant contaminates the benthic environment below the depths covered in sublittoral assessments, sampling will be performed to document contamination of the sediment and organisms associated with the sediment.

A. Field Sampling

1. If the depth of water exceeds safe operating depth for SCUBA divers and economically valuable shellfish beds are not

included in the affected biota, sampling will involve the collection of benthic organisms by otter trawl and sediment grabs. Replicate trawls and grab samples will be taken throughout the suspected area of contamination and at one or more control stations. A photo sled may also be used under appropriate conditions.

2. If shellfish beds are involved and water depth exceeds safe limits (20 meters) for SCUBA divers, a type of dredge capable of efficiently harvesting a deep water shellfish bed should be employed in sampling the bed.

3. Samples collected in the field will be sealed in an appropriate non-contaminating container, labeled, and frozen until analyzed in the lab.

4. Appropriate analytical methods will be utilized in the lab to investigate possible contamination of sediments and tissue.

5. Static receiving water assays (Appendix IX) using the pollutant and contaminated sediments will be used to determine toxicity of pollutant to benthic organisms.

6. Damage assessment claims will be based on loss of revenue from commercial benthic fisheries in the region.

13. DAMAGE ASSESSMENT OF PHYSICAL FACILITIES

1. Get photographic documentation of damage. Names and addresses of witnesses and their counter signature on photographs and description of damages is desirable.

2. Keep all invoices for cleanup materials, replacement parts, and equipment rentals.

3. Keep accurate time sheets and travel expenditures for all personnel involved in cleanup.

4. A photographic record of predamage condition, impact damages, various stages of cleanup or repair, and rehabilitated structure is recommended.

5. Record of improvements or repair of damage not related to pollution incident must be kept spearate and not included in damage claim.

14. EVALUATION OF ECONOMIC LOSS

Economic loss to the state will be based on the most recent statistics available from the state agencies with jurisdiction over affected resources.

A. Park Lands

(No. of activity occasions/day x value/activity occasion) + (operation costs/day) + (amortization of idle investment/day) + (average revenue income/day) x (number of days of closure or reduced utilization) = Economic Damage Assessment.

Values to be supplied by P&RC.

B. Public Lands

(value/man-day) x (length of closure) = Economic Damage Assessment.

Values to be supplied by DNR/WDF.

C. Recreational Fishing

(value/man-hour) x (number of man-hours lost) = Economic Damage Assessment.

Values to be supplied by WDF. If freshwater game fish are impacted, their values will be supplied by WDG.

D. Commercial Fishing

$$\left(\frac{\text{value}}{\text{catch}} \times \frac{\text{catch}}{\text{effort}}\right)_1 - \left(\frac{\text{value}}{\text{catch}} \times \frac{\text{catch}}{\text{effort}}\right)_2 = \text{Economic Damage Assessment}$$

where: 1 = before pollution incident

2 = after pollution incident

Values to be supplied by WDF.

E. State Revenue

(projected tax revenue + licenses and fees) - (actual collections)

Values to be supplied by appropriate state agencies.

APPENDIX IX

LABORATORY ASSESSMENT PROCEDURES

INTRODUCTION

While field sampling programs are sufficient to document quantitative changes in the abundance of organisms in a pollution-affected environment, they are seldom capable of documenting the physiological effects a given pollutant has in bringing about changes in the abundance of organisms in the affected environment. The physiological effects the pollutant has on living organisms requires laboratory testing.

State-of-the-art procedures acceptable to the scientific community will be used for all laboratory testing. Specific methodologies for the various analyses are not included because testing regimes vary according to the chemical nature of the pollutant and the continuous improvement in instrumentation and development of new analytical techniques.

1. CHEMICAL ANALYSES

A. Pollutant Identification

1. Chemical identification of the pollutant and identification of the pollutant in water, sediment, and tissue samples will be performed by qualified laboratories using state-of-the-art methodologies.

2. BIOASSAY

A. Static Acute Toxicity

1. Bioassay methodology will be based on the 48-hour exposure method using bivalve mollusc embryos described in the American Society for Testing and Materials' proposed methods for acute toxicity tests *Standard Practice for Conducting Basic Toxicity Tests with Fishes, Macroinvertebrates, and Amphibians* or *Standard Practice for Conducting Static Acute Toxicity Tests with Larvae of Four Species of Bivalve Molluscs*.

B. Toxicity to Impacted Species

1. Bioassay methodology will be based on the receiving water bioassay methodology used by WDF (Cardwell and Woelke, 1979 and Hirota et al., 1977).

2. Organisms bioassayed will be meroplankton larvae of economically important species collected from reference stations adjacent impacted waters (Appendix VIII).

3. TAINTING
(Pollutant Exposure-related Tastes and Odors)

A. Taste Panel

1. Species tested will be limited to important commercial and recreational species. Selection of species for testing will rest with the WDF and DSHS.

2. Organisms for testing may be collected during pollutant impact-related sampling operations or separately if collected from affected areas.

3. The first organisms for testing should be collected 2 to 9 weeks after exposure to the pollutant with subsequent sampling every 3 weeks.

4. Subsamples (either whole organisms or parts thereof) of each sample shall be tested for contamination (tissue retention of the pollutant) (Appendix VIII).

5. The rest of the sample will be turned over to the Department of Food Science and Technology, College of Fisheries, University of Washington, or a similar organization for taste-testing by panels drawn from the general public.

APPENDIX X

DOE BASELINE METHODOLOGIES
A. INTERTIDAL SAMPLING AND PROCESSING METHODS

Revised October 1980

I. Determination of Sample Locations

The basic purpose for determining critically the location of sample sites is to enable the investigator to extrapolate his data from these sample locations to all similar areas within his area of concern. Therefore, a method which permits statistical subsampling of all the beach types should be used. The first step, called the characterization phase, would be to segregate all the shoreline areas into habitat types, as defined by the Department of Ecology such as marshes, mud flats, sand beaches, rocky beaches, mixed, and eelgrass beds. The location of the habitat types would then be mapped, using aerial photography, spot-checking with ground inspections, as well as a review of previous studies in the area.

The number of beaches chosen to be sampled during the Baseline phase should be in proportion to (a) the extent of each habitat type, (b) the expected amount of variability between beaches of similar habitat characteristics, and (c) the sensitivity or importance of the habitat type to human activities.

For habitat types of limited extent such as only one or two examples or short stretches of beach then only one beach need be examined. If there are several miles of beach, then at least two areas should be chosen. If the habitat type covers a hundred miles, then five or more sites may be chosen.

Beach types such as rocky shores and mixed that can have a wide range in exposure to wave action, water temperature, and salinity, should be segregated and subsampled on the basis of these variables. For example, there may be six one-mile beach segments that are classified as mixed. Two are in exposed locations with low annual water temperatures and high salinities. Three are in protected locations near river mouths with a wide range of temperatures and salinities. The last beach is intermediate. In this situation, one beach of each type should be sampled.

Certain habitat types such as eelgrass beds and protected mixed beaches can be affected dramatically by siltation in the water. The eelgrass can be covered with sediment which lowers the ability of the plant to produce organic materials from sunlight and can result in a die off of the beds. Mixed beaches can be covered with silt, smothering the benthic animals and preventing the settlement of larvae. In addition, eelgrass beds are important nursery and feeding areas for commercially and recreationally important species, while mixed habitats often contain numbers of economically important clam species. Therefore, these areas should be sampled in at least two locations over a five-mile stretch.

In addition to choosing the number of sites based on the above considerations, access and funding limitations must be recognized.

Assuming that access is primarily from the uplands, where roads must be found and permission to cross private property sought, the candidate sites may have to be reduced. In addition, 57 percent of the tidelands of Washington are private, so permission must also be secured from the owners to sample. Reduction of sites should be based on a priority basis starting with common minimal impact sites.

II. Method of Random Sampling to Document Distribution of Organisms

A. Permanent Reference and Baseline

All intertidal stations must have at least one permanent tidal reference point marked on an immovable object on the backshore or in the intertidal. Each mark is calibrated approximately to a tidal height either from a USCGS marker, if close by, or from a given water level under average weather conditions using NOAA tidal predictions and any appropriate corrections in them known for the specific location.

The reference marks have several purposes. Using a transit, they permit a relative tidal height determination for all quadrats sampled at the station. They permit return to the same heights for any subsequent sampling. They also permit eventual exact tidal height determination of all quadrats if the absolute tidal height of the reference points are ever determined.

The reference line is a line located parallel to the water at the upper tidal boundary of each station's high intertidal zone. The reference line length may vary from area to area. The objective is to stay within the same habitat type at each station. In linearly homogeneous areas, a length of up to 100 m may be used. In more heterogeneous or physically restricted areas as little as 25 m may be available.

B. Transect Lines

Each time an intertidal station is sampled, transect lines are placed perpendicular to the baseline. It is along these transect lines that samples are taken. Depending upon the habitat type, one or more transect lines are used. In mud and sand where the community is more evenly distributed, and working distances longer, one transect line is used. However, if the area is variable horizontally, then two transects should be made. On gravel, cobble, and rock habitats, two or more parallel transect lines are used.

To assure the randomness required for statistical analysis of quantitative data, the transect line positions are chosen without bias. This is done by choosing a random number which falls within the meter boundaries of the baseline for the first transect line. Any feasible geometric means, such as a

transit, is used to assure that the transect lines are perpendicular to the baseline. The second and subsequent transect lines are placed 15 meters apart.

C. Quadrat Locations and Number

The transect line (or lines) distance is measured from the reference line to the minus 0.5 meter level, if possible, or to the lowest practical sampling level based upon the low tides during the sampling period. Quadrats are obtained at each foot of tidal height from mean higher high-water to the low tide line as determined by USGS in that area. Once these levels are determined, they are staked or permamently marked. These stakes represent quadrat locations. Quadrats should not be reoccupied in subsequent sampling.

D. Quadrat Heights

The permanent reference marks at all stations are at a known distance above or below a selected high tide of a certain date. This correlation allows a matching scale between intertidal stations based on the amount of air exposure the beaches will receive. This scale can be made comparable to normal corrected tide table levels. For each quadrat on the beach the distance below, or in some cases above, the high tide datum mark is recorded.

This method is used because a given tide table prediction lacks known accuracy. A table determined low tide in many of the sampling stations would, because of this problem, plus, the seasonally occurring beach slope shifts, produce extremely crude tide height levels.

E. Photographs

Photographs of each quadrat before sampling the beach, at each sample level, and a panoramic view of the habitats on the beach including the reference line should be taken as a historical record, a quantitative tool in rocky areas, and to illustrate seasonal differences if they occur.

F. Timing of Sampling

Distribution sampling should be done at least once preferably during the late spring or early summer - whenever population distributions of significant species are at a maximum. If dramatic seasonal changes are suspected in significant species or communities, then another sampling should be made at their distributional minimum.

III. Method of Stratified Random Sampling to Document Representative Abundance of Organisms

A. Permanent Reference and Baseline

The Baseline is established in the same manner as in Section II A.

B. Transect Lines

Three levels at each area are sampled using horizontal transect lines, unless distributional data indicate that adequate sampling of significant populations should be accomplished with fewer or greater number of levels. The suggested levels are as follows: high intertidal (mean high water to mean sea level), middle intertidal (mean sea level to mean low water), and low intertidal (mean low water to extreme low water). Once these levels are determined for each study area based on the distribution of organisms on the Significant Biological Resources List (or if those species are not present in significant amounts, then the location is based upon the distribution of the dominant community in each zone) and referenced to the permanent tidal marker, the same levels are returned to for any subsequent sampling on a seasonal basis. The horizontal transect lines are located by measuring from the vertical line using a transit.

C. Quadrat Locations

A 25 to 100 m (depending on horizontal heterogenity and practicality) horizontal transect line is laid out following the tidal height contour decided upon. The locations of quadrats to be sampled along the transect are determined from a random number table.

D. Quadrat Number

1. Soft-substrata

At least two 0.05 m^2 x 15 cm. deep samples per horizontal transect are taken for dead-sieving in the laboratory after fixation in formalin. At least three 0.15 m^2 x 30 cm deep samples are taken for live-sieving on the beach. Photographs of the surface of each quadrat are taken prior to sampling.

2. Hard-substrata

At least three 0.15 m^2 samples are removed after being photographed. Scattered barnacles with no other organisms may be photographed and counts made from the photographs.

E. Timing of Sampling

Abundance data should be obtained at least during the biological summer. If data indicate large seasonal fluctuations, then samples should be obtained in other seasons as appropriate.

IV. Methods for Sampling Quadrats

A. Rock

A .25 m^2 frame which is sectioned into twenty-five .01 m^2 units is placed over the quadrat location. First, an estimate of the percentage of algae cover is made based upon the averaged estimates of two or more observers. Next, all the algae within the entire .25 m^2 area is removed. With this accomplished, larger (5mm) invertebrates are removed from within the .25 m^2 frame. Five .01 m^2 sections are selected randomly, and these are separately scraped clean of all algae and invertebrates.

B. Cobble

A 0.25 m^2 frame which is sectioned into twenty-five 0.01 m^2 units is placed over the quadrat location. After first photographing, all the algae within the entire 0.25 m^2 area is removed. With this accomplished, larger (5+ mm) invertebrates are removed from the surface of the 0.25 m^2 area and from beneath the larger cobble, being careful to replace each rock after the removal of organisms. Next, five randomly selected 0.01 m^2 sections are scraped clean of all remaining algae and invertebrates and containerized separately.

Following this, a 0.05 m^2 frame is placed randomly within the 0.25 m^2 frame. Sediment from within this smaller frame is removed to a depth of 15 cm. This is placed in a container of 600 ml of pure formalin (40 percent formaldehyde in water); seawater is added to cover the sediment; and it all is gently stirred to assure good mixing of the formalin.

On every other quadrat of each transect line a .25 m^2 frame is placed adjacent to the already cleared frame. A 0.25 x 30 cm sample is dug diagonally adjacent to alternate .05 m^2 samples. The sediment is excavated out of this frame to a depth of 30 cm and passed live through a 12.5 mm sieve. Bivalves and crustaceans are retained (20 percent seawater/formaldehyde solution).

C. Gravel

A .05 m^2 frame is placed at the quadrat location. Sediment from within is removed to a depth of 15 cm. The sediment is fixed as above and dead-sieved in the laboratory through a 1 mm screen. Large cores are taken (.25 m^2 x 20 cm) and processed as in cobble section.

D. Sand

Same method as in gravel.

E. Mud

Same method as in sand.

F. Quadrat Rejection

Certain quadrats may fall upon obviously dissimilar habitat types such as on a rock on a mud flat. These quadrats should be rejected and another quadrat chosen at the same location.

V. Field and Laboratory Procedures

A. Field Handling

Samples from the field are containerized and tagged as to location, date, quadrat number, and collection method. Each different collection method within a quadrat is stored and tagged separately from other collection methods within the same quadrat.

B. Supporting Measurements

Prior to sampling, the temperature and salinity of the shoreline water 0.25 m below the surface should be obtained and recorded along with prevailing weather conditions. Beach slope and composition from M.H.H.W. to the low-water line should be recorded, if different from the first sampling.

C. Preservation

All live-sieved samples and algae are preserved in the field in a 10 percent buffered ($CACO_3$) formaldehyde/seawater solution. Immediately upon reaching the laboratory, prior to processing, they should be transferred to a fresh 10 percent buffered formaldehyde/seawater solution or 70 percent ethanol with 5 percent glycerin for animals and a 4 percent ethanol seawater solution for algae. Algae should be stored in darkness to prevent bleaching.

D. Processing

1. .01 m^2 Scrapes - Rock and Cobble Habitats

The five subsamples are kept separate at all times. Each is emptied into a sorting pan. Use separate algae samples to calculate percent missed from scrape. Next, the material, including washings from the algae, is run through a 1 mm sieve. The material left has organisms separated from the detritus and algae. They are then visually grouped into organism types with general common characteristics and placed into petri dishes. All the petri dishes, along with their identification tags, are then preserved with a 70 percent alcohol and 5 percent glycerin solution and sent to shelves to wait for identification.

2. .05 m^2 x 15 cm - Cobble, Sand, Mud, Habitats

   The sample is then run through a 1 mm sieve after 24-hour fixation. The sample is then dyed with rose bengal (or phloxine-B) and bottled for two days. Material is then placed in a sorting pan and visible organisms removed and placed into petri dishes. Petri dishes and their tags go to shelves to wait for identification.

3. .25 m^2 Rock, Cobble, Habitats

   Organisms and algae from the sample are floated in a sorting pan. Algae removed from within the .25 m^2 quadrat by a .01 m^2 or .05 m^2 scrape is also placed with this sample. The organisms and algae are then visually sorted as to types and placed in petri dishes. Wet weight is then obtained for each species. It is preserved with 4 percent buffered formaldehyde/seawater solution to await identification as needed. Algae is preserved as in 5C.

4. .25 m^2 x 30 cm, 12.5 mm Live-Sieved - Cobble, Gravel, Sand, Mud Habitats

   These organisms are cleaned under running water, preserved as above, and sent to the identification table.

Identification is attempted to the species level for all organisms 1 mm and larger, beginning with those on the Significant Biological Species list of the Department of Ecology. The number of individuals for each species for each collection method within a quadrat is obtained. Organisms with an aggregrate weight of less than .1 gram are not weighed. The length of bivalves is given in mm of those caught greater than 10 mm.

All organisms collected from the sample stations are finally stored. Each collection method from each station's quadrats is preserved and containerized separately. These are placed in a larger container filled with preservative, holding all of an individual quadrat's smaples. Algae is preserved in formalin and invertebrates in 70 percent alcohol with 15 percent glycerin.

A museum collection is then made of representatives of all species collected by the study. Taxonomic identification should be given with location, date, key used, and quadrat number.

E. Identification Keys

1. The primary key to invertebrates is Kozloff, E. N., 1974. Keys to the Marine Invertebrates of Puget Sound, the San Juan Archipelago and Adjacent Regions. University of Washington Press, Seattle and London.

2. For algae, basic identification is made from the following:

   For generic names, Scagel, R. F., 1957. Annotated List of Marine Algae of British Columbia and Northern Washington. National Museum of Canada, Biology Series No. 52, Bulletin No. 150.

   For green algae, Scagel, R. F., 1966. Marine Algae of British Columbia and Northern Washington - Part I: Chlorophyceae (green algae). National Museum of Canada, Biology Series No. 74, Bulletin No. 207.

   For brown algae, Widdowson, T. B., 1973. The Marine Algae of British Columbia and Northern Washington: revised list and keys. Part I. Phaeophyceae. Syesis 6:81-96.

   For red algae, Widdowson, T. B., 1974. The Marine Algae of British Columbia and Northern Washington: revised list and keys. Part II. Rhodophyceae. Syesis 7:143-186.

3. Other keys are used as aids or additions: Banse, Karl and K. D. Hobson, 1974. Benthic Errantiate Polychaetes of British Columbia and Washington. Bulletin. Fisheries Research Board of Canada 185.

   Berkeley and Berkeley. 1952. Annelida Polychaete Sedentaria. (9b(2)). Fisheries Research Board of Canada. University of Toronto Press.

   Pettibone, M. H., 1953. Some Scale-Bearing Polychaetes of Puget Sound and Adjacent Waters. University of Washington Press, Seattle.

   Barnard, J. L., 1969. The Families and Genera of Marine Gammaridean Amphipoda. Bulletin. U. S. National Museum 271:1-535.

   Quayle, D. B., 1970. The Intertidal Bivalves of British Columbia. British Columbia Museum Handbook 17.

   Griffith, L. M., 1967. The Intertidal Univalves of British Columbia. British Columbia Museum Handbook 26.

   Rice, T., 1971. Marine Shells of the Pacific Northwest. Ellison Industries, Inc., Edmonds, Washington.

Light's Manual - Intertidal Invertebrates of the Central California Coast, Third Edition., Ed. Ralph I. Smith and James T. Carlton. 1975.

VI. Data Analysis

The following should be provided for each station:

1. General location map showing shoreline configuration, low-tide line, roads, and other significant shoreline features.

2. Detailed site map showing the winter and summer distribution of sediments, algae beds, eelgrass beds and other significant features.

3. Diagrams of the winter and summer vertical distributions of dominant and/or significant organisms and species listed on the Significant Biological Resources List by life history stage and sediment distributions.

4. Graphs of the seasonal vertical distribution of dominant and/or significant organisms and species listed on the Significant Biological Resources List by life history stage.

5. Graphs of the seasonal vertical abundance of dominant and/or significant organisms and species listed on the Significant Biological Resources List by life history stage.

6. Graphs of the seasonal variation in water temperature and salinity.

7. Textual discussion of station characteristics, sampling and processing methods, results (including appropriate tables listing species abundance by life history stage with means and standard deviations for all organisms collected for each collecting period). A discussion section describing the seasonal distribution and abundance of organisms by life history stage found at the station and relationship to measured water and sediment characteristics as well as other factors (such as unusual weather or human impact) that may have influenced the observed community characteristics.

8. Field data entered on the forms provided by the Department of Ecology.

The following should be provided for all stations:

1. A general map of the entire area of concern showing all stations. The shorleine, roads, and other significant features should be included on the map.

2. A textual discussion with supporting diagrams and graphs of interstation characteristics and differences relative to sediment and organisms.

3. A species-by-species discussion of distribution and abundance of life history stages found over all stations and seasons including causal factors (where known) determining the distribution and abundance pattern.

B. BEACH SEINE SAMPLING AND PROCESSING METHODS FOR BASELINE STUDIES

State of Washington
Department of Ecology

Revised October 1980

I. Selection of sample sites should receive the same care and consideration discussed under intertidal sampling (Appendix XIA). Also, care should be exercised in the location of sample sites to ensure that they do not contain obstructions to the use of the beach seine.

II. Beach Seine Construction

The beach seine is a haul seine which is set parallel to shore and hauled to the beach, concentrating the fish into a fine-meshed bag centered between the net's larger-meshed wings.

A. Net

The standard net (Figure 1) is 37-m long. A 0.6 m-wide by 2.4-m deep by 2.3 m-long bag is situated between the two 18 m-long wings. The 2.9 cm mesh wings taper from widths of 0.9 m at the ends to 2.4 m adjacent to the bag; the bag is constructed of 0.6 cm mesh webbing. Wooden poles are attached to each end of the net, leading to bridles where the hauling lines are attached.

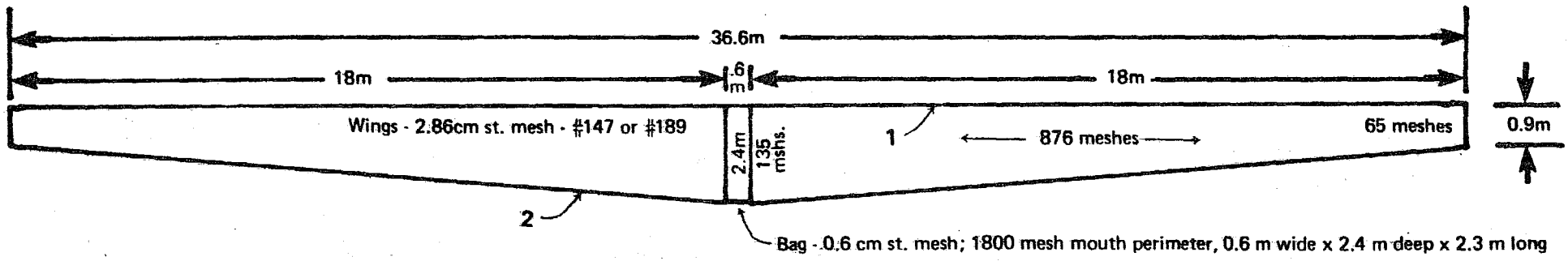
The net utilized in the Baseline Studies Program is a convertible net that can be used for sampling both demersal and pelagic fish in the intertidal and nearshore subtidal. The net designed to sweep the bottom has a solid core lead line and a 3.8 cm by 6.4 cm float every sixth hanging along the float (top) line. It is converted to the floating configuration by the addition of seven 12.7 cm x 27.9 cm "T" floats which are clipped on along the float line--three along each wing and one over the bag.

B. Hauling Lines

The lines attached to the bridles and poles at the ends of the beach seine are 1.27 cm singlebraid polypropylene rope 60 m to 90 m long. The lines are marked at 10 m intervals.

III. Setting of the Net

A boat is utilized as a platform from which the net is set, either from the stern of a rowed skiff or from the bow of a powered skiff. The net is laid in layers on a sheet of wood or canvas so that when the boat is underway, the net plays out evenly (Figure 2).



1 3.8 cm x 6.4 cm float every 6th hanging; convert to floating seine with seven 12.7 cm x 27.9 cm 'T' floats

2 Solid core lead line

Figure 1. Convertible beach seine utilized during Nearshore Fish Survey

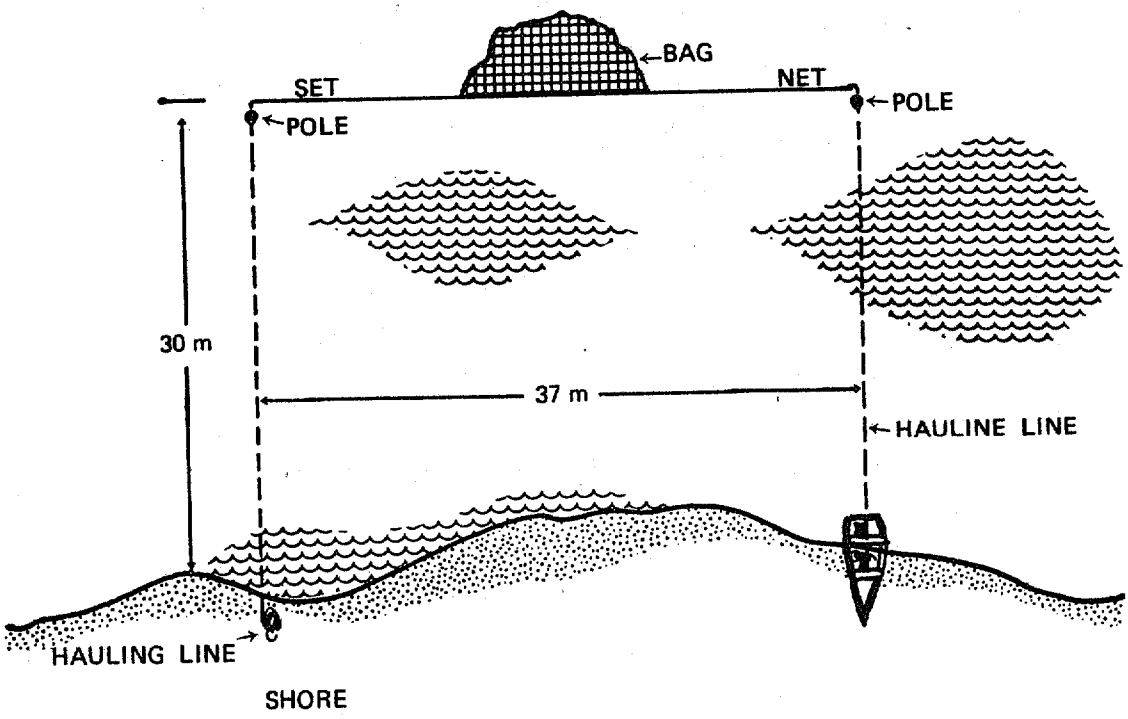


Figure 2. Position of set beach seine before hauling.

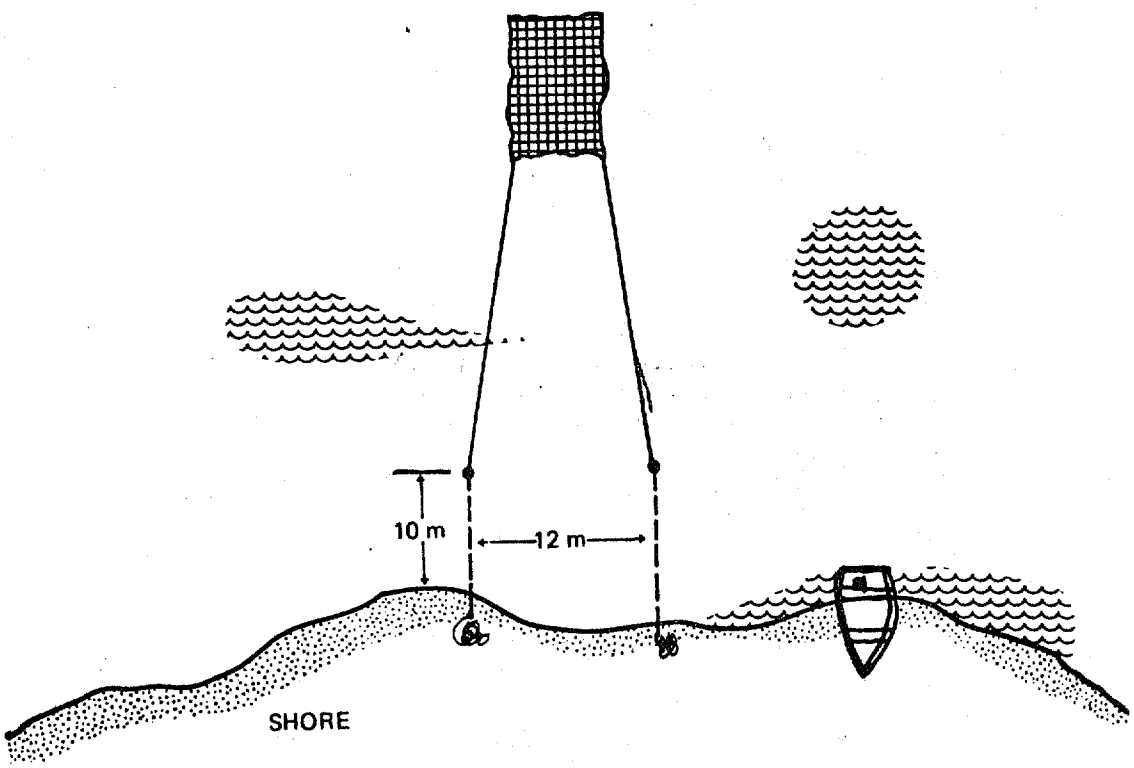


Figure 3. Position of beach seine hauled to within 10 m of shore.

One line is attached to the net and paid out from shore, the individuals on this line directing the boatmen to begin setting the net when 30 m of line has been stretched between the water's edge and the boat. The net is then paid out evenly as the boat is rowed parallel to shore. It is important that the bag is arranged on the boat so that it deploys in the water with the opening facing shoreward and is not rolled or twisted in any manner. When all the net has been paid out, the boat is then rowed directly back to shore, the boatmen paying out the other hauling line which is attached to that end of the net. The boat should reach the shore at a point perpendicular to that end of the net, approximately 37 m from the beginning point; it is helpful to place a marker on the beach at this distance to guide the boatmen.

If any current is in evidence, the boat should be rowed or powered "upstream" and the net initially set in a parallelogram configuration so that by the time it is ready to be hauled, it is perpendicular to the shore "stations"; this will be especially necessary when fishing the floating seine.

Note that the net should not be set directly over a dense eelgrass bed as it will roll up in the process of being hauled in. Once the net is moving, however, it will pass over scattered eelgrass clumps without rolling.

IV. Net Retrieval

Once the net is set, it should be hauled in without delay. Two individuals can handle each hauling line, pulling it in hand-over-hand at 10 m/min., calling out each 10 m interval mark passed on the hauling lines. When 10 m of line is remaining and the poles have just become visible (in the case of the sinking net), the haulers should move in toward each other until they are about 12 m apart (Figure 3). One person on each side wades out to the bridle pole to guide it in with the lead line on the bottom and to the inside. The net is then hauled the rest of the way onto the shore. At all times it is very important to make sure that the lead line is not raised off the bottom; once the net is on shore, hauling should be done either from the bridles or the lead line but never along the float line as this raises the lead line farther along the net.

V. Collecting and Processing

Organisms captured in the seine haul should be retrieved from the wings and bag or "worked" along the wings and into the bag where they can be concentrated and removed. All fish collected should be placed in plastic bags with appropriate labels. A representative sample of invertebrates is separately bagged. If the catch is excessively large (over 2,000 to 3,000 fish), it should be properly subsampled and apply to an excessively large catch of one species as well as a large mixed catch. The bagged organisms should be refrigerated until processing can take place, usually from one-half

to six hours later, depending upon the sampling method and the eventual use of the specimens--e.g., specimens destined for stomach analyses are to be processed as soon as is practical, never more than two hours later. The specimens for stomach analysis are preserved in 20 percent buffered ($CaCO_3$) formaldehyde/seawater solution. Larger specimens (larger than 20 cm) should have their belly walls slit to permit rapid fixation.

The above methods have been designed to eliminate subsampling of catches and every attempt should be made to avoid subsampling. Occasions do occur, however, when catches are too excessive to be physically handled within the available time and budget constraints. Only in these cases should subsampling be allowed.

There are two types of subsampling circumstances:

1. Subsampling the total catch for catch composition, abundance, and biomass estimates.

2. Subsampling within a species for abundance, biomass, and representative length, weight, sex, etc., information.

When subsampling the total catch, the fish should be a homogeneous mixture of species before subsampling. This can be accomplished by mixing by hand or observing that they are evenly mixed. Using a scoop balance pan or similar container, take uniform, successive samples from the catch, retaining every tenth sample. The other nine samples should be returned down current or otherwise away from the sample area.

The resultant subsamples should give you one-tenth of the original catch.

The subsample is then sorted to species and life history stage. These fish are counted and weighed. The total catch is estimated from the subsamples as well as species life history, weights, and numbers.

When an excessively large catch of one species is made, a minimum of 50 fish of each life history stage is obtained randomly (25 from each of two hauls). The total catch is then estimated from those subsamples.

VI. Time and Number of Collections

In order to concentrate fish occupying the intertidal region, beach seining should routinely be performed during the extreme low tide series of the monthly lunar cycle. Actual collections should be made as close to the low slack tide period as is possible. In collections involving both sinking and floating seines, those made with the sinking seine should be made at low tide, the floating seine collections immediately before or after. (In shallow beach regions, only one net collection is neceesary since the two nets fish the same water column.) Two replicate hauls (two adjacent

hauls) constitute one collection. Habitats should be inventoried at least four times per year (seasonally) with added emphasis on the more productive late spring, early summer months, and early fall months.

VII. Date Collection

For all collections and hauls, the location, date, time, tide, weather, and oceanographic and other pertinent environmental information are recorded at the time of sampling. Water samples are obtained, and sample bottle numbers recorded, for salinity and dissolved oxygen determination by either laboratory chemical analyses or in situ instrument readings. All information is directly recorded on computer format coded forms provided by the Department of Ecology.

Each fish sample is sorted according to species which as a group are enumerated and weighted. In addition, for each species, individual total length (to nearest mm) and weight (to nearest 0.1 g) measurements for representative numbers (25 if available) of each species life history stage are obtained, as is evidence of external disease, parasites, and abnormalities. Sex, age, and stomach contents for selected subsamples of economically or ecologically important species may also be obtained. All catch and individual specimen data are directly recorded on computer-format coded forms to be provided by the Department of Ecology.

VIII. Taxonomy

The principal reference for identification of Puget Sound marine fishes is Hart, J.L., 1973, Pacific Fishes of Canada, Fish. Res. Board Can. Bull. 180. If the identification of any species is in question, it should be given to the College of Fisheries, University of Washington, for verification.

IX. Data Analysis

The following should be provided for each station:

1. General location map showing shoreline configuration, low tide line, roads, and other significant shoreline features.

2. Detailed site map showing the winter and summer distribution of sediments, algae beds, eelgrass beds, and other significant features.

3. Graphs of the seasonal distribution of dominant and/or significant organisms and species listed on the Significant Biological Resource List by life history stage.

4. Graphs of the seasonal vertical abundance of dominant and/or significant organisms and species listed on the Significant Biological Resources List by life history stage.

5. Graphs of the seasonal variation in water temperature and salinity.

6. Textual discussion of station characteristics, sampling and processing methods, results (including appropriate tables listing species abundance by life history stage with means and standard deviations for all organisms collected for each collecting period). A discussion section describing the seasonal distribution and abundance of organisms by life history stage found at the station and relationship to measured water and sediment characteristics as well as other factors (such as unusual weather or human impact) that may have influenced the observed community characteristics.

7. Field data entered on the forms provided by the Department of Ecology.

The following should be provided for all stations:

1. A general map of the entire area of concern showing all stations. The shoreline, roads, and other significant features should be included on the map.

2. A textual discussion with supporting diagrams and graphs of interstation characteristics and differences relative to sediment and organisms.

3. A species-by-species discussion of distribution and abundance of life history stages found over all stations and seasons including casual factors (where known) determining the distribution and abundance pattern.

C. SUBSTRATE CLASSIFICATION OF THE MARINE AND ESTUARINE AQUATIC LANDS OF WASHINGTON* **

TYPE	CHARACTERISTICS
Inorganic	
Solid Rock	continuous or repeated strata
Boulder	256 mm in diameter or greater
Cobble	64 to 256 mm
Pebble-Gravel	4 to 64 mm
Sand	
very coarse	1 to 4 mm
coarse	0.5 mm to 1 mm
medium	0.25 mm to 0.5 mm
fine	0.12 mm to 0.25
very fine	0.06 mm to 0.12 mm
Silt	0.06 mm to 0.004 mm
Clay	0.004 mm or less
Organic	
Shell fragments	Calcium carbonate; contains fragments of clam or snail shells.
Detritus	Accumulated wood, sticks, and other undecayed coarse plant material.
Fibrous peat	Partially decomposed plant remains; parts of plants readily distinguishable.
Pulpy peat	Very finely divided plant remains; parts of plants not distinguishable; varies in color from green to brown; varies greatly in consistence often being semifluid.
Muck	Black, finely divided organic matter; completely decomposed.
Eelgrass	Zostera nana, Zostera marina
Kelp	"Bullwhip kelp" (nereocystis primarily) but also ulva, laminaria, fucus, etc.

*NOTE: Data on beach geology and wave hydrodynamics indicate that beach slope and substrate characteristics are generally related to wave and/or current action. Therefore, in most cases (except for rocky areas) characterization of beaches and beds by substrate type will be providing information on the beach slope and wave and/or current energy history. Many beaches in the Pacific Northwest are not just of one type of substrate. Upper zones can be of coarser materials, and the further toward the water you go, the finer the sediments become.

**From North Puget Sound Baseline Study 1974-1977. Fred Gardner (editor). Baseline Studies Program, Washington State Department of Ecology.

D. GENERAL HABITAT CHARACTERISTICS*

The habitats which are described on the following pages are composites of literature reviews and field sampling. They do not represent a particular place (unless specifically named), these descriptions, however, should fit the variety of habitats you could encounter in northern Puget Sound.

Open Water

Beyond the shoreline and away from the immediate influence of the sea bottom are organisms that float and swim in search of food within the water column. This is the open water habitat. The greater majority of organisms in this habitat are microscopic, single-celled plants called diatoms and dinoflagellates which serve as food for the dominant animals which are copepods. To one not aware of biological food chains, they are seemingly unimportant to man because of their small size. However, it is this small size that makes possible their ability to stay within the lighted surface waters and allows for their rapid reproduction. Microscopic plants such as diatoms and dinoflagellates feed copepods and larvae, which in turn feed herring and other small fish which ultimately feed salmon. Passing through the open water habitat are migrants such as salmon, herring, birds, seals, and whales. In addition, eggs released by bottom, shoreline, and open water species can be concentrated at the surface. Jellyfish are also frequently found at the surface.

Stratification of the water column begins at the surface where river water, rainfall, and solar heating cause changes in temperature and salinity forming a temporary barrier to settling particles and food materials. Below this seasonal pycnocline (the marked density boundary between the upper and lower water masses) is the regional pycnocline which reflects the oceanographic conditions off the coast of Washington and Canada. The role of these pycnoclines in controlling the distribution of the phytoplankton and zooplankton and, therefore, commercially important fish, is not well understood.

No previously published studies exist as to oil mixing at the pycnocline depths and the possible consequences to the life that exists there. Associated with tidal channels are logs, seaweed, and other organic debris displaced from the shorelines. It is possible that these areas of rafted debris are also rich food resource areas for open water occupants. Also important might be the potential entrapment of tidally mixed oil at the boundary between the upper tidal turbulent waters and the deeper basinal waters.

Subtidal Habitats

Beneath the open water habitat and seaward of the intertidal shoreline are several diverse environments for shellfish, bottom fish, and shrimp. In these subtidal environments, organisms depend on food reaching the bottom through the water or transported along the

sea bottom by currents. Food to these deep areas may also be transported by predator/prey activity, forming a food ladder between the various depths.

In current-swept rocky areas such as tidal channels where most food is in suspension, forms of bottom life are adapted to drawing the food particles from the water. Included in this group of suspension feeders are; sponges, sea anemones, and worms. Organisms capable of grasping tightly to the rocks, such as starfish, sea urchins, and abalone, move about in search of food. In tidal delta areas, where tidal channel debris settles, both suspended and deposited food are abundant, supporting perhaps the most populated and diverse community. Here large geoducks, crabs, tunicates, worms, and many other organisms can live in great abundance because of readily available food in the water and in the bottom sediment. At levels where the pycnocline intersects the sea floor, there are many accumulation sites of good and organic debris supporting higher numbers of suspension and deposit feeders. In the deeper portions of Puget Sound, green muds, rich in diatoms and other organic debris, support primarily deposit feeding worms, sea urchins, and small delicate clams.

Rocky Habitats

Rocky habitats display a diversity of both plant and animal life especially adapted to withstand pounding surf and a wide range of temperatures, salinities, and oxygen concentrations. Much of the seaweed and other organic debris which washes ashore on beaches or accumulates in the subtidal habitat is derived from rocky habitats, and provides food for detritus feeders. Small snails such as littorines and limpets crawl about in the upper portions of the rocks eating algae and organic debris. Barnacles are abundant in this environemnt and have adapted to withstand weeks without food. At the midtide level, snails, starfish, and some fish prey on these barnacles and on mussels, usually more abundant in this level.

The midzone usually shows increases in brown, red, and green seaweeds but rockweed seems to be best adapted, especially in turbulent rocky habitats. Organisms without protective shell coverings become more abundant and include sea anemones, sponges, and tunicates. The purple crabs, normally found in cracks or under loose rocks, search out organic debris and dead organisms killed by shifting boulders during periods of large tidal currents or high surf activity. At the lower tide levels, larger green, brown, and red seaweed occur. Especially characteristic of this lower level are increased occurrences of starfish, sea cucumbers, and sea anemones.

Schools of black and yellowtail rockfish, kelp greenling, and some herring are the common fishes observed among the kelp. Sculpins, gunnels, and cabezon are found in the lower regions of this habitat, while ratfish, dogfish, and lingcod are frequently observed in the deepest areas.

Mixed-Coarse Habitats

Life in the mixed-coarse habitats is dependent on the presence of large boulders, which serve as attachment sites for algae and lessen the impact of waves. In these areas, shore crabs are very abundant in the midtide levels. In the higher reaches of the beach, driftwood and algal debris accumulate providing refuge for sand fleas. The lower zone is typically lush with algae, and attached to cobbles and boulders are large brown and red seaweed. In the lower tidal zone with the sediment are butter clams and cockles as well as numerous amphipods and worms that provide abundant food for fish.

In contrast, mixed habitats devoid of boulders and sand flats, directly impacted by the surf, result in shifting substrates and are devoid or have sparse populations of such organisms as seaweeds, clams, littorines, and shore crabs. Open water fish of this habitat such as herring, some salmon fry, and shoreline fish such as buffalo sculpins, sculpins, and tubesnouts tolerate this increased surf activity.

Mixed-Fine Habitats

Most of the mixed-fine habitats are found in protected embayments adjacent to rocky areas or near river deltas where the bottom consists of gravel, sand, and mud. These protected habitats provide shelter and rich food supplies for many fish. Fish apparently seek out these protected habitats during stormy weather and during winter months. In these embayments organic debris settles, providing food for the abundant small clams, shrimp, and worms. Sediment type of the upper beach is dominated by gravels grading into sand and mud offshore. The lower portion of the shoreline normally contains abundant worm and clam holes, attesting to its richness.

In embayments which have sufficient surface area for wind waves to develop, loose gravel and sand are concentrated on the intertidal beach slopes. These sediments normally contain fewer organisms with the sediment, but still have high amphipod concentrations to support large fish populations. When located next to kelp or eelgrass beds, such as a Deadman Bay, a great variety of fish species exist.

Sand Habitat

Life in sandy beaches at first glance appears to be neither abundant nor diverse. Organisms in this habitat seek shelter within the sediment and are dependent on the microscopic food found between the sand grains, or pump seawater through their body to strain microscopic particles from the water. However, a walk along the beach observing debris tossed by a storm begins to reveal that large organisms live in this habitat. Included are Dungeness crabs, cockles, and butter clams. The upper beach is often strewn with drift logs and swash debris rich with sand fleas and set on top of loose tan colored dry sands. Midway down the beach slope,

the sand is wet and grey, and holes left by burrowing organisms are more apparent. Between the sand grains are found numerous types of diatoms and detritus serving as food for clams, worms, and small crustaceans. At the lower levels, large moon snails, clusters of algae may occur, providing food and refuge for such organisms as crabs and fish. Because of the vast extent of these eelgrass beds and their importance in northern Puget Sound, the characteristics of this habitat are discussed separately. Sandy habitats are also important to fish, especially herring and sand lance which lay their eggs in the upper regions. Also visiting these habitats during high tide are juvenile flat fish, perch, salmon fry, and a host of other fishes.

Mud Habitat

As in the sandy habitats, the abundance and diversity of life in the mud environment is not readily apparent. It is life from these habitats which serves as food for so many of Washington's shoreline birds and fish. During high tide, humans cannot see through the turbid water, yet during these periods, flat fish and other fish migrate shoreward feeding on the abundant worms, clams, and crustaceans. Also during these flood tides, ghost shrimp and crabs leave their burrows in search of food, which in turn exposes them to predation by these fish. Many of the mud flats of northern Puget Sound have upper slopes composed of rock, cobble or pebble substrate, supporting seaweeds, crabs, and small snails. Oysters are occasionally found attached to these substrates, but are rarely found in large concentrations, as they are in the southern portion of Puget Sound. Spills in these habitats would be next to impossible to clean up because of the extensive areas of soft muds involved and incorporation of the oil into the worm tube burrows and clam holes.

Eelgrass Habitat

Eelgrass beds are most commonly found at the low tide level in sandy or muddy habitats, providing refuge for juvenile fish. Although not extensive, eelgrass beds are also found in mixed-coarse and fine habitats. In addition, eelgrass acts as attachment sites for some organisms while it provides food directly or indirectly to others. Attached to the blades are diatoms, seaweeds, sea anemones, bryozoans, and hydroids. Crawling about the leaves can be small crabs, sea slugs, snails, isopods, and small crustaceans. At their base, crabs, shrimp, and fish seek food and shelter. The eelgrass tends to trap dead blades and algae debris, providing detritus for worms, clams, and a host of other organisms. Much of the detritus decays, providing enriched sites for micro-algae and additional food for many organisms including worms and clams, which in turn feed crabs, fish, and birds.

Salt Marsh Habitats

Bordering tide flats and usually found adjacent to rivers are marshes, consisting of various types of grasses that provide shelter

for nesting and foraging birds. These marshes are inundated only during the highest tides or times of river flooding. During these periods, large amounts of organic detritus and silt are left behind, enriching the soil. This organic influx is responsible for the high production which can exceed six times that of a wheatfield. On the seaward margin, picklewood with associated small snails and crabs may occur. Further landward, grasses, and reed plants prevail, offering refuge for birds and other animals. These salt marshes and grasses stabilize the river deltas, especially during times of high tides or flooding rivers. Organic matter derived from salt marshes is believed to be an important source of food for offshore marine species.

Kelp Habitats

The large brown seaweeds or kelp beds that prevail in rocky habitats provide protection and food for various organisms. The fronds (leaves) of these large seaweeds reduce wave action or turbulence of the water making food collection by birds and other organisms easier. Schools of herring, rockfish, and greenling commonly seek their protection. Varying densities of these plants influence bottom populations of many organisms, affecting the ability of these habitats to support fish. Associated with the kelp beds, and attached to rocks, are abolones, sea urchins, and scallops.

Manmade Habitats

Breakwaters, marinas, piers, docks, harbors, mounds of dumped dredged debris, navigational channels, and bottoms which have been influenced by sewers or industrial wastes all provide unnatural habitats for marine life. The influence of manmade habitats on the natural marine populations is just beginning to be studied and understood. Breakwaters and marinas may enhance the adjacent habitats by providing added kelp debris from their rocky surfaces. Areas protected from waves and currents provide shelter from winter storms. This same protection, however, may also trap organic debris and pollutants such as oils. Piers and floating docks have unique sites for attachment of seaweeds, colonial diatoms, hydroids, worms, sea anemones, sea squirts, and many predators that feed upon these organisms. Shadows cast by these structures inhibit the growth of algae, decreasing the food supplying of herbivorous animals. Piers and harbors prevent plant growth, but in turn provide shelter and food from the pilings. Most dredged materials come from nearshore areas or riverbeds. This sediment is normally high in wood debris, coarse-rock material and at times, industrial pollutants. Dredged materials, when dumped in offshore environments, usually present the benthic occupants with a radically different environment. Few studies have been made in Puget Sound regarding repopulation of dredge dump sites and these populations or communities may differ from the adjacent normal populations. One study which was done was the Grays Harbor dredging fate and effects study; funded by the Corps of Engineers in 1974, through the Department of Ecology.

Although deepening river channels has impact on life on the river bottom, dredging is necessary to maintain ship traffic lanes. As industrial complexes grow adjacent to these navigational lanes, waste debris accumulates in the channels which may have serious effect on food for migratory salmon.

Sewage which has accumulated on the sea bottom provides a unique habitat for life because it is exceedingly rich in organic matter. What organisms ultimately occupy these sewage sludge sites, or whether uptake of harmful components occurs, is poorly understood. In addition, knowledge of how these sites may change with time or influence the surrounding habitats is not documented. Because of the complexity of these habitats and limited areal extent, their study was not incorporated into the northern Puget Sound Studies.

APPENDIX XI

SIGNIFICANT BIOLOGICAL RESOURCES OF WASHINGTON*

The following 336 species of marine-oriented animals and plants have been placed on this list on the basis of one or more of the following criteria:

1. Commercially obtained for food or for industrial products.

2. Recreationally important.

3. A known important food item of a commercial or recreational species.

4. A known important predator or competitor on a commercial or recreational species or on a food item of a commercial or recreational species.

5. Established values of species will be based on Stokes (1979).

MAMMALS: Open Water

Scientific Name	Common Name
Emuetopias jubata	Northern sea lion
Zalophus californianus	California sea lion
Phoca vitulina	Harbor Seal
Callorhinus ursinus	North Pacific fur seal
Mirounga angus tirostris	Northern elephant seal
Orcinus orca	Pacific killer whale
Globiccphala scammonii	Pacific blackfish
Phococna phocoena	Pacific harbor porpoise
Eschrichtius glaucus	Gray whale
Balaenoptera physalus	Finback whale
Megaptera novaeangliae	Humpback whale
Lageonorhynchus obliquidens	Pacific white-sided dolphin
Delphinus delphis	Common dolphin
Stenella styx	Gray porpoise
Berardius bairdi	Baird beaked whale
Mesoplodon stejnegeri	Stejneger beaked whale
Ziphius cavirostris	Goose-beaked whale
Physeter catodon	Spern whale
Kogia breviceps	Pygmy sperm whale
Lissodelphis borealis	Northern right whale dolphin
Phocoenvides dalli	Dall porpoise
Grampus griseus	Grampus dolphin

*Taken from North Puget Sound Baseline Program 1974-1977. 1978. Fred Gardner (Ed.) Washington State Department of Ecology, Baseline Studies Program. pp 50 to 53.

MAMMALS: Shoreline

Scientific Name	Common Name
Lutra canadensis	River otter
Enhydra lutris lutris	Sea otter

BIRDS: Open Water

Scientific Name	Common Name
Gavia immer	Common Loon
Gavia arctica pacifica	Pacific Arctic Loon
Gavia stellata	Red-Throated Loon
Podiceps grisegena	Holboel Red-Necked Grebe
Podiceps auritus cornutus	Horned Grebe
Podiceps nigricollis californicus	American Eared Grebe
Aechmophus occidentalis	Western Grebe
Phalacrocorax auritus cincinatus	White-Crested Cormorant
Phalacrocorax auritus albociliatus	Northwestern Double-Crested Cormorant
Phalacrocorax auritus	Double-Crested Cormorant
Phalacrocorax penicillatus	Brant's Cormorant
Phalacrocorax pelagicus resplendens	Baird Pelagic Cormorant
Olor columbianus	Whistling Swan*
Branta canadensis occidentalis	Western Canada Goose*
Branta nigricans	Black Brant*
Anser albifrons fontalis	Pacific White-Fronted Goose*
Chen caerulescens caerulescens	Lesser Snow Goose*
Anas platyrhynchos platyrhynchos	Mallard*
Anas acuta	Pintail
Anas crecca carolinensis	Green Winged Teal
Anas americana	American Wigeon
Anas clypeata	Northern Shoveler
Aythya valisineria	Canvasback
Aythya marila nearctica	Greater Scaup
Aythya affinis	Lesser Scaup
Bucephala clangula americana	Common Goldeneye
Bucephala islandica	Barrow's Goldeneye
Bucephala albeola	Bufflehead
Clangula hyemalis	Oldsquaw
Histrionicus histrionicus	Harlequin Duck
Melanitta deglandi dixoni	Western White-Winged Scoter
Melanitta perspicillata	Surf Scoter
Melanitta nigra	Black Scoter
Mergus merganser americanus	Common Merganser
Mergus serrator	Red Breasted Merganser
Fulica americana americana	American Coot*
Stercorarius parasiticus	Parasitic Jaeger
Larus glaucescens	Glaucous-Winged Gull*
Larus occidentalis occidentalis	Western Gull*

*Taken from North Puget Sound Baseline Program 1974-1977. 1978. Fred Gardner (Ed.) Washington State Department of Ecology, Baseline Studies Program. pp 50 to 53.

BIRDS: Open Water (continued)

Scientific Name	Common Name
Larus argentatus	Herring Gull*
Larus californicus	California Gull*
Larus delawarensis	Ring-Billed Gull*
Larus canus	Mew Gull*
Larus philadelphia	Bonaparte's Gull
Larus heermanni	Heermann's Gull*
Larus thayeri	Thayer's Gull*
Sterna hirundo hirundo	Common Tern
Uria aalge claifornica	Common Murre
Cepphus columba	Pigeon Guillemot
Brachyramphus marmoratus marmoratus	Marbled Murrelet
Ptychoramphus aleutica	Cassin's Auklet
Cerorhinca monocerata	Rinoceros Auklet
Lunda cirrhata	Tufted Puffin
Steganopus tricolor	Wilsons Phalorope
Lobipes lobatus	Northern Phalorope
Diomedea nigripes	Black-Footed Albatross
Fulmarus glacialis	Northern Fulmar
Puffinus creatopus	Pink-Footed Shearwater
Puffinus griscus	Sooty Shearwater
Oceanodroma furcata plumbea	Southern Fork-Tailed Storm Petrel
Pelecanus occidentalis	Brown Pelican
Stecorarius pomarinus	Pomarine Jaeger
Stercorarius longicaudus	Long-Tailed Jaeger
Rissa tridactyla	Black-Legged Kittiwake
Xema sabini	Sabine's Gull
Sterna forsteri	Forster's Tern
Childonias niger	Black Tern
Hydroprogne caspia	Caspian Tern
Synthliboramphus antiquum	Ancient Murrelet
Podilymbus podiceps	Pied-Billed Grebe
Larus hyperboreus barrovianus	Glaucous Gull*
Olor buccinator	Trumpeter Swan
Catharacta skua	Skua

*also found on shore

BIRDS: Shorebirds

Scientific Name	Common Name
Ardea herodias fannini	Northwestern Great Blue Heron
Numenius phaeopus	Whimbrel
Actitis macularia	Spotted Sandpiper
Heteroscclus incanum	Wandering Tattler
Tringa melanoleucus	Greater Yellowlegs
Tringa flavipes	Lesser Yellowlegs

*Taken from North Puget Sound Baseline Program 1974-1977. 1978. Fred Gardner (Ed.) Washington State Department of Ecology, Baseline Studies Program. pp 50 to 53.

BIRDS: Shorebirds (continued)

Scientific Name	Common Name
Calidris canutus rufa	American Knot
Califdris melanotos	Pectoral Sandpiper
Calidris minutilla	Least Sandpiper
Calidris alpina	Dunlin
Limnodromus griscus caurinus	Short-Billed Dowitcher
Limnodromus scolopaceus	Long-Billed Dowitcher
Calidris mauri	Western Sandpiper
Calidris alba	Sanderling
Heamatopus bachmani	Black Oyetercatcher
Charadrius semipalmatus	Semipalmated Plover
Charadrius vociferus vociferus	Killdeer
Squatarola squatarola	Black-Bellied Plover
Aphriza virgata	Surfbird
Arenaria interpres	Ruddy Trunstone
Arenaria melanocephala	Black Turnstone
Butorides virescens anthonyi	Green Heron
Butaurus lentiginosus	American Bittern
Calidris acuminata	Sharp-Tailed Sandpiper
Calidris pusillus	Semipalmated Sandpiper

BIRDS: Casual Marine Feeders

Scientific Name	Common Name
Megacerylc alcyon	Belted Kingfisher
Corvus caurinus	Northwestern Cros
Haliaeetus leucocephalus	Bald Eagle
Pandion haliaetus	Osprey

FISHES: Offshore -- Bottom Oriented

Scientific Name	Common Name
Anoplopoma fimbria	Sablefish
Ophiodon elongatus	Lingcod
Citharichthys sordidus	Pacific sand dab
Atheresthes stomias	Arrow tooth flounder
Eopsetta jordani	Petrale sole
Glyptocephalis zachirus	Rex sole
Hippoglossus stenolepis	Pacific halibut
Isopsetta isolepis	Butter sole
Lepidopsetta bilineata	Rock sole
Microstomus pacificus	Dover sole
Parophrys vetulus	English sole
Platichthys stellatus	Starry flounder
Pleuronichthys coenosus	C-O sole
Pleuronichthys decurrens	Curlfin sole
Psettichthys melanosticus	Sand sole
Hippoglossoides elassodon	Flathead sole

FISHES: Offshore -- Bottom Oriented (continued)

Scientific Name	Common Name
Lyopsetta exilis	Slender sole
Porichthys notatus	Plain-fin midshipman
Gadus macrocephalus	Pacific cod
Merluccius productus	Pacific hake
Microgadus proximus	Pacific tomcod
Theragra chalcogrammus	Walleye pollock
Anarrhichthys ocellatus	Wolfeel
Sebastes alutus	Pacific Ocean perch
Sebastes brevispinis	Shortspine rockfish
Sebastes caurinus	Copper rockfish
Sebastes emphaeus	Puget Sound rockfish
Sebastes flavidus	Yellowtail rockfish
Sebastes malanops	Black rockfish
Sebastes paucipinis	Bocaccio
Sebastes ruberrimus	Red snapper
Sebastes pinniger	Orange rockfish
Sebastes goodei	Chilipepper rockfish
Sebastes babcocki	Flag rockfish
Sebastes aleutianus	Rougheye rockfish
Sebastes diploproa	Splitnose rockfish
Sebastes elongatus	Greenstriped rockfish
Sebastes auriculatus	Brown rockfish
Sebastes proriger	Redstripe rockfish
Sebastes nebulosus	China rockfish
Sebastes entomelas	Widow rockfish
Sebastes mystinus	Blue rockfish
Sebastes miniatus	Vermillion rockfish
Raja bionculata	Big Skate
Raja rhina	Longnose skate
Hydrolagus colliei	Ratfish
Acipenser transmontanus	White sturgeon
Acipenser medirostris	Green sturgeon
Citharichthys stigmaeus	Speckled sand dab
Torpedo californica	Pacific electric ray

FISHES: Shoreline

Scientific Name	Common Name
Salmo clarki clarki	Sea-run cutthroat trout
Hexagrammos decagrammus	Kelp greenling
Hexagrammos lagocephalus	Rock greenling
Hexagrammos stelleri	Whitespotted greenling
Enophrys bison	Buffalo sculpin
Hemilepidotus hemilepidotus	Red Irish lord
Leptocottus armatus	Pacific staghorn sculpin
Oligocottus maculosus	Tidepool sculpin
Scorpaenichthys marmoratus	Cabezon
Amphistichus rhodoterus	Redtail surfperch

FISHES: Shoreline (continued)

Scientific Name	Common Name
Brachyistius frenatus	Kelp perch
Cymatogaster aggregata	Shiner perch
Embiotoca lateralis	Striped seaperch
Hyperprosopon argenteum	Walleye surfperch
Rhacochilus vacca	Pile perch
Phanderodon furcatus	White sea perch
Apodichthys flavidus	Penpoint gunnel
Pholis ornata	Saddleback gunnel
Pholis laeta	Crescent gunnel
Sebastes maliger	Quillback rockfish
Roccus saxatilis	Striped bass
Atherinops affinis affinis	Top smelt
Gasterosteus aculeatus	Threespined stickleback
Hyperprosopon ellipticum	Silver surfperch
Lumpenus sagitta	Snake prickleback
Clevelandia ios	Arrow goby
Oxylebius pictus	Painted greenling
Salvelinus malma	Dolly Varden

FISHES: Open Water

Scientific Name	Common Name
Sardinops sagax	Pacific sardine
Alosa sapidissima	American shad
Clupea harengus pallasi	Pacific herring
Engraulis mordax mordax	Northern anchovy
Oncorhynchus tshawytscha	Chinook salmon
Oncorhynchus kisutch	Coho salmon
Oncorhynchus gorbuscha	Pink salmon
Oncorhynchus nerka	Sockeye salmon
Oncorhynchus keta	Chum salmon
Oncorhynchus masu	Masu salmon
Salmo gairdneri	Steelhead (rainbow trout)
Hypomesus pretiosus pretiosus	Surf smelt
Spirinchus thaleichthys	Longfin smelt
Thaleichthys pacificus	Eulachon
Mallotus villosus	Capelin
Cynoscion nobilis	White sea bass
Ammodytes hexapterus	Pacific sand lance
Squalus acanthias	Spiny dogfish
Cetorninus maximus	Basking shark
Prionace glauca	Blue shark
Lamma ditropis	Salmon shark
Galeorhinus zyopterus	Soupfin shark
Alopias vulpinus	Thresher shark
Carcharodon carcharias	White shark
Trachurus symmetricus	Jack mackerel
Thunnus alalunga	Albacore

FISHES: Open Water

Scientific Name	Common Name
Scomber japonicus	Chub mackerel
Mola mola	Ocean sunfish
Cololabis saira	Pacific saury
Erilepis zonifer	Skilfish
Euthynnus pelamis	Skipjack tuna

ECHINODERMS: Offshore -- Bottom Oriented

Scientific Name	Common Name
Parastichopus californicus	Sea cucumber
Strongylocentrotus droebachiensis	Green urchin
Strongylocentrotus fransiscanus	Red urchin
Strongylocentrotus purpuratus	Purple sea urchin
Pycnopodia helianthoides	Sunflower starfish
Dendraster excentricus	Sand dollar

ECHINODERMS: Shoreline

Scientific Name	Common Name
Pisaster ochraceus	Purple starfish

CRUSTACEANS: Offshore -- Bottom Oriented

Scientific Name	Common Name
Pandalus jordani	Ocean pink shrimp
Pandalus borealis	Pink shrimp
Pandalopsis dispar	Sidestripe shrimp
Pandalus platyceros	Spot shrimp
Pandalus dane	Dock shrimp
Pandalus goniurus	Coonstripe shrimp
Pandalus hypsinotus	Coonstripe shrimp
Lopholithodes formaminatus	Box Crab
Cancer magister	Dungeness crab
Cancer productus	Red rock crab
Lopholithodes mandtii	Puget Sound king crab
Pugettia gracilis	Kelp crab
Callianassa californiensis	Ghost shrimp
Chinonoecetes tanneri	Tanner crab
Pandalopsis ampla	Shrimp
Heptacarpus stimpsoni	Broken back shrimp
Upogebia pugettensis	Burrowing shrimp

CRUSTACEANS: Shoreline

Scientific Name	Common Name
Orchestria traskiana	Sand flea
Idotea resecata	Beach isopod
Idotea wosnesenski	Beach isopod
Balanus glandula	Barnacle
Balanus cariosus	Barnacle
Hemigrapsus nudus	Purple shore crab
Hemigrapsus oregonensis	Hairy shore crab
Cancer oregonensis	Shore crab

CRUSTACEANS: Open Water

Scientific Name	Common Name
Epilabidocera amphitrites	Copepod
Holmesiella anomala	Mysid
Euphausia pacifica	Euphausid
Thysanoessa longipes	Euphausid
Calanus sp.	Copepod
Microcalanus sp.	Copepod
Pseudocalanus sp.	Copepod

ANNELIDS

Scientific Name	Common Name
Nereis vexillosa	Pile worm
Lumbrineris sp.	Pile worm
Abarenicola pacifica	Lug worm
Chaetopterus variopedatus	Lug worm

SCYPHOZOA

Scientific Name	Common Name
Aurellia aurita	Jellyfish
Aequorea aequorea	Jellyfish

ANTHOZOA

Scientific Name	Common Name
Anthopleura xanthogrammica	Sea anemone
Anthopleura elegantissima	Sea anemone

MOLLUSCS: Offshore -- Bottom Oriented

Scientific Name	Common Name
Ostrea lurida	Olympia oyster
Haliotis rufesceans	Red abalone

MOLLUSCS: Shoreline (continued)

Scientific Name	Common Name
Haliotis kamtschatkana	Northern abalone
Panope generosa	Geoduck
Chlamys hastata hericia	Pacific pink scallop
Pecten caurinus	Sea scallop
Hinnites multirugosus	Rock scallop
Chlamys hindsi (rubida)	Hinds' scallop
Octopus hongkongensis	Octopus
Octopus dofleini	Octopus
Archidoris nobilis	Sea lemon

MOLLUSCS: Shoreline

Scientific Name	Common Name
Crassostrea virginica	Eastern oyster
Crassostrea gigas	Japanese oyster
Crassostrea gigas kumamoto	Kumamoto oyster
Mytilus edulis	Blue mussel
Mytilus californianus	California mussel
Haliotis rufesceans	Red abalone
Saxidomus giganteus	Butter clam
Clinocardium nuttalli	Common cockle
Tresus nuttalli	Horse clam
Tresus capax	Big neck
Mya arenaria	Soft shell clam
Venerupis japonica	Japanese little neck
Zirfaea pilsbryi	Piddock
Siliqua patula	Razor clam
Protothaca staminea	Rock or native little neck
Polinices lewisii	Moon snail
Thais lamellosa	Wrinkled purple snail
Cryptochiton stelleri	Giant gunboat chiton
Mopalia lignosa	Chiton
Urosalpinx cinerea	Native drill
Ocinebra japonica	Japanese oyster drill

MOLLUSCS: Open Water

Scientific Name	Common Name
Loligo opalescens	Pacific Coast squid

SEAWEEDS: Offshore -- Bottom Oriented

Scientific Name	Common Name
Iridaea cordata	Red algae
Nereocystis luetkeana	Brown kelp, bullwhip kelp
Macrocystis pyrifera	Kelp

SEAWEEDS: Offshore -- Bottom Oriented (continued)

Scientific Name	Common Name
Macrocystis integrifolia	Brown algae, kelp
Prophyra porphyra nereocystis	Red algae, nori
Laminaria saccharina	Brown algae, kelp

SEAWEEDS: Shoreline

Scientific Name	Common Name
Gigartina papillata	Red algae
Gigartina exasperata	Red algae
Porphyra perforata patiens (torta)	Red algae, nori
Porphyra perforata perforata	Red algae, nori
Porphyra miniata	Red algae, nori
Porphyra san jaunensis	Red algae, nori
Porphyra abbottae	Red algae, nori
Prophyra porphyra nereocystis	Red algae, nori
Fucus gardneri	Brown algae, rockweed
Ulva lactuca	Green algae

PHYTOPLANKTON

Scientific Name
Skeletonena costatum
Pheodactylum tricornutum
Nitzchia closterium
Chaetoceros decipiens
Chaetoceros armatum
Asterionella japonica
Monochrysis lutheri

GRASSES

Scientific Name	Common Name
Zostera nana	Eelgrass
Zostera marina	Eelgrass
Phyllospadix scouleri	Surf grass
Distichlis spicata	Green seashore salt grass
Spartina gracilis	Alkali cord-grass
Salicornia virginia	Pickleweed
Triglochin maritimum	Arrow grass

APPENDIX XII

LITERATURE CITED

Cardwell, R.D. and C.E. Woelke, 1979. Marine Water Quality Compendium of Washington State. Vol. I, Wash. St. Dept. Fisheries, Olympia WA, pp. 4-12

Clark, R.C., Jr. and D.W. Brown, 1977. Petroleum: Properties and analyses in biotic and abiotic systems. In Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms, D.C. Malins (ed.). Academic Press, Inc., New York NY pp. 2-89

Coon, L.M., E.J. Field, and Canadian Benthic LTD, 1976 (second printing 1977). Nootka Sound Kelp Inventory, 1975. Fisheries Management Report No. 2, British Columbia Marine Resources Branch, Ministry of Recreation and Conservation, Providence of British Columbia, 28 pp. (copies available from Harry Tracy, DOE)

EPA, 1979a. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. Environmental Protection Agency, Pub. No. EPA-600/4-79-019.

EPA, 1979b. Methods for Chemical Analysis of Water and Wastes. Environmental Protection Agency, Pub. No. EPA-600/4-79-020.

EPA, 1972. Field Detection and Damage Assessment Manual. Environmental Protection Agency, Contract No. 68-01-0113.

Everitt, R. D., 1979. Marine Mammals of Northern Puget Sound and the Strait of Juan de Fuca - A Report on Investigations Nov. 1, 1977 - Oct. 31, 1978. Marine Ecosystem Analysis Program, Boulder CO, NOAA Tech. Memorandum ERL MESA-41, 191 pp.

Foreman, R.E., 1975. KIM-1, a Method for Inventory of Floating Kelps and Its Application to Selected Areas of Kelp License Area 12. Final Report File No. 5506-81-131-1-72. BERP Report 75-1. 19 pp.

Gardner, F. (ed.), 1978. North Puget Sound Baseline Study, 1974-1977. Baseline Studies Program, Washington State Dept. of Ecology, pp 6, 22-24, and 50-53.

Gonor, J.J. and P.F. Kemp, 1978. Procedures for Quantitative Ecological Assessments in Intertidal Environments. Environmental Protection Agency, Pub. No. EPA-600/3-78-087.

Goodwin, C. L., 1973a. Distribution and Abundance of Subtidal Hardshell Clams in Puget Sound, Washington. Wash. St. Dept. Fisheries, Olympia WA Tech. Rept. No. 14, 81 pp.

Goodwin, C. L., 1973b. Subtidal Goeducks of Puget Sound, Washington. Wash. St. Dept. Fisheries, Olympia WA Tech. Rept. No. 13, 64 pp.

Hirota, J., R. D. Cardwell, A. W. Kendall, Jr., P. A. LaRock, S. M. Novak, and N. J. Prouse, 1977. The Plankton in Oil Spill Studies: Strategies and Techniques. American Petroleum Institute, Washington DC, Publ. No. 4286, chapter 4, pp. 40-56

Lemberg, N., 1978. Hydroacoustic Assessment of Puget Sound Herring, 1972-1978. Wash. St. Dept. Fisheries, Tech. Rept. No. 41

Manuwel, D. A., T. R. Wahl, and S. M. Speich, 1979. The Seasonal Distribution and Abundance of Marine Bird Population in the Strait of Juan de Fuca and Northern Puget Sound in 1978. Marine Ecosystems Analysis Program, Boulder CO, NOAA Tech. Memorandum ERL MESA-44, 391 pp.

Miller, B. S., C. A. Simensted, L. L. Moulton, K. L. Fresh, F. C. Funk, W. A. Karp, and S. F. Borton, 1978. Puget Sound Baseline Program Nearshore Fish Survey. Report No. 10, Appendix D - Nearshore Fishes. Wash. St. Dept. Ecology Baseline Study Program, Olympia WA, p. 6

Penttila, D., 1978. Studies of Surf Smelt (Hypomesus pretiosus) in Puget Sound. Wash. St. Dept. Fisheries, Olympia WA. Tech. Rept. No. 42, 47 pp.

Stickel, L.F. and M.P. Dieter, 1979. Ecological and Physiological/Toxicological Effects of Petroleum on Aquatic Birds. U.S. Fish & Wildl. Svc., Biol. Serv. Prog. FWS/OBS-79/23. 14 pp.

Stokes, R. L., 1979. Economic Evaluation of Marine Biological Resources. Economic Report Phase II, Appendix O. Wash. St. Dept. Ecology Baseline Study Program, Olympia WA. 36 pp.

Tegelburg, H., and D. Magoon, 1968. Razor Clam Fisheries and Sampling Program. Wash. State Dept. Fisheries. Progress report.

Tracy, H. B. and J. C. Bernhardt, 1974. For Investigating Oil Pollution Complaints in Washington State. Wash. St. Dept. Ecology, Tech. Rept. No. 74-4., 40 pp.

Wahl, T. R. and S. M. Speich, 1980. Marine Bird Populations in Washington Waters, Impact Documentation and Long-Term Monitoring. Wash. St. Dept. Ecology. Final Report, Contract No. 80-100 CZMA. Unpublished.

CREDITS TO CONTRIBUTORS

Many people devoted their time and energy to the development of the MRDA response plan. The authors are grateful for these efforts as stated in the adknowledgments. Others prepared written documents of a technical nature for inclusion in the plan. These individuals are given credit for their work by section and page number below. Their efforts also are greatly appreciated:

Method for Assessment of Affected Bird Populations
Section 3, Page VIII-9; Dr. Terry Wahl and Dr. Steve Speich, University of Washington

Sampling Procedure: Hard Shell Clams
Section B, Page VIII-16; Al Scholz, Washington Department of Fisheries

Method for Assessment of Herring Populations
Section 6, Page VIII-20; Bob Trumble, Washington Department of Fisheries

Method for Assessment of Smelt Populations
Section 7, Page VIII-22; Bob Trumble, Washington Department of Fisheries